GREENROOFS
PHYTO-MATERIALITY AND ECOTOPIA

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Thesis submitted for the degree of Doctor of Philosophy
(PhD)

2015

Declaration

I, Jane Dickson confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

With growing concerns over human relations with respect to Nature within the Anthropocene increasingly expressed in terms of changing climates, the agentive relations between humans and the world come more sharply into anthropological focus. Cities, often described as devoid of Nature, are currently being recognised as one way to govern the twin problems of managing a changing climate and an increasingly compact city form. There are currently, 700 green (deliberately vegetated) roofs in place in London. This thesis examines the material culture of greenroofs, through a re-evaluation of J J Gibson's Affordance Theory. Materials and plants in combination provide the conditions for agentive action, not only for flora and fauna but for people. I propose that these resulting socio-biological capacities be described as phyto-materiality.

This phyto-materiality becomes central to flexible and ongoing classificatory practices which, in turn, enables greenroofs to become incorporated into a palimpsest of policy-making at the local and city levels and facilitates the mainstreaming of greenroofing practice.

During a greenroofing project, phyto-materiality becomes central to achieve movement across geographical and organisational boundaries re-shaping the governance of London's built environment and the working practices of professionals. However the material effects of greenroofing become problematic as imagined future plants become a source of concern for leaseholders or current flora and fauna escape the roof, revealing tensions and fractures in greenroofing practice.

The thesis is informed by more than a year's participant observation within a local authority and a network of greenroof designers, builders, ecologists, policymakers and ecological activists. Greenroofing comes out of an engagement with British environmental discourses and in making greenroofs and greenroof policy-making people remake themselves as greenroofers. For these respondents, phyto-materiality becomes

both the ends-in-sight vision of, and the methodology for, ecotopia.

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List of Abbreviations

ALMO Arms Length Management Organisation
BAP Biodiversity Action Plan
BREEAM Building Research Establishment Environmental Assessment Method
DEFRA Department for Environment, Food and Rural Affairs
ESS Ecosystems Services
FR Footprint Replacement
GI Green Infrastructure
GLA Greater London Authority
HAP Habitat Action Plan
LEED Leadership in Energy and Environmental Design
LDF Local Development Framework
LWT London Wildlife Trust
MEA Millennium Ecosystem Assessment
PPP Public Private Partnership
RE Reconciliation Ecology
RISC Reading International Solidarity Centre
SAP Species Action Plan
SPARs Species-area relationships
SUDs Sustainable Urban Drainage
UCL University College London
UEL University of East London
UHIE Urban heat island effect
ER Ecological Restoration
RE Reconciliation Ecology

Local Authority:

CS Core Strategy

CSP Core Strategy Policy

DMT Departmental Management Team

DP Development Policy

KPI Key Performance Indicators

NI National Indicator

OSS Open Space Strategy

PPS Planning and Policy Statements

RLO Resident Liaison Officer

SPD Supplementary Planning Documents

The *Living Roofs and Walls: Technical Report, Supporting London Plan Policy* (2008) has been shortened throughout to: *The Technical Report*.

Acknowledgements

As everybody who reaches the point of writing their acknowledgements knows, there are hundreds of people who have helped, contributed, supported and enlivened a research project such as this. Some contributions are so great and freely given that they can never be fully repaid, so I can only thank respondents from the bottom of my heart.

There are some who deserve special thanks such as Tom who welcomed me into his team and Frank, who has become and remains a firm friend. They have also been kind enough to review several chapters. Dusty, Gary and Blanche were all generous with their time and expertise.

Victor Buchli's supervision and advice guided this project. While he remains modest about it, it is in no small part due to him that I was able to both start and finish. Yvonne Rydin's extensive knowledge of policy and environmental issues is matched only by her critical skills and generosity.

Rob O'Brien (1967-2012) introduced me to *The Anthropology of Policy* by Shore and Wright in one of his classes and it was his enthusiasm and dedication which sparked my interest in processes of governance.

The happiest man in the world must indeed be my husband Bruce Durling. Surely now, finally, please, he can stop hearing about plant agency and greenroofs?

Bruce do not be too sure…

1

Introduction

> Climate change is not 'a problem' waiting for 'a solution'. It is an environmental, cultural and political phenomenon which is reshaping the way we think about ourselves, our societies and humanity's place on Earth (Hulme 2009:frontispiece).

There are now approximately 700 roofs in London which have been deliberately vegetated: covered in layers of plants and used for gardens, social spaces, vegetable growing and for increasing the amount of biodiversity in the city. Non-greened roofs are being redefined as "visually 'dead' and unappealing" (Gedge:2014), "wasted spaces" (Sharp:2008) and in London as "some of the capital's most underused assets" (PoliticsHome website:2006). In the US, American roofs have become the "last urban 'frontier' " (Greenroofs.org:2012). Redefining and discovering them as spaces of potential shifts roofs to roofscapes.[1] Grant (2006) identifies a possible 24,000 hectares, 16% of Greater London which could be covered with greenroofs and The Chartered Institution of Building Services Engineers estimates 200 million m^2 of potential greenroof space across the UK (CIBSE:2007). Roofs are now ready to be greened, ready to provide space for problem solving within the urban environment. Currently there are just under 700 in London according to the Greenspace Information for Greater

[1] In terms of solar PV technology, roofs are being described as: "a sleeping asset" (Why Solar?) and "roofs will have to work harder" (Crook:2010).

London organisation (GiGL:2013)[2] with many other private greenroofs which remain uncounted. As *The Technical Report* exclaims; "it is time to make our roofs places for life" (GLA 2008:1).

Green (deliberately vegetated) roofs have multiple forms, multiple uses and employ an established commercial production model to solve multiple problems in the urban environment. They can be inexpensive, DIY, or expensive, corporate and exclusive. They can be private, commercial, individual, company, park, garden, sedum mat-based, vegetable-growing, or tree-containing. They can be managed, enhanced, neglected, retrofitted and isolated, inviting or inaccessible. They can even be polite or scruffy. However, as greenroofers say: "there is nothing, nothing, in green technology that does more, is as beneficial as a greenroof" (Gedge interview:2011).

With growing concerns over human relations with respect to 'nature' within the Anthropocene (Crutzen and Stoermer:2000) increasingly expressed in terms of changing climates, the agentive relations between humans and the world come more sharply into anthropological focus. In this light, I examine J J Gibson's affordance theory (1977). "The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (Gibson 1986:127). Affordances are features of materiality which become actionable when an agent uses them, thus Bloomfield et al.'s (2010) contention that affordances are not simply material qualities, but events.

While Gibson dismisses plants as un-sensate and "lumped together with the inorganic minerals of the world" (Gibson 1977:7), new advances in biological research have found plants are agentively capable and the theory now requires reevaluation. Plants are involved in activities through which agency is emergent, in relation to human sociality and apart from it. Plants make change possible, allow people to reach consensus over management of the built environment and they are used in the provision of ecosystems services (ESS).

Greenroofs are 'effective configurations' (Suchman:2006) of the affordances of living and non-living materials brought together for human and non-human life. Affordances are expressed as benefits and the production of this phyto-materiality enables the creation of new ecosystems. Greenroofs realign multiple concerns over the environmental management of London. They are operationalised and standardized through funding streams and the creation of policy. This provides alignments with the already standardized materials and practices of the built environment. Committed communities of practice (Wenger:1999) work to create roofscapes 'for nature' and

[2]GiGL are an environmental records centre and I am indebted to them for the yearly use of their database on greenroofs in London. They can be found at www.gigl.org.uk

'for people' at the societal scale. Bulkeley and Newell (2010) contend that the communities of practice, which cluster around sustainability are hierarchical and by contrast some of Latour's (2005) actor networks ignore power and authority and appear ontologically flat. The landscape of greenroof networks, by contrast, is shifting and relational, with social actors, social tools and ontologies rising and falling, shifting and realigning to act upon and produce the materiality of nature as much as they are produced by it.

Plants achieve and exercise agentive capabilities, not because humans extend (Gell:1998) agency to them, but because agency is emergent from the relations between plants and their environment which provides them with affordances. There is now sufficient scientific evidence to support the claim that plants are sensate and make definite choices. They possess agentive capabilities independent of contact with the human social. Greenroofers reveal a knowledge of and confidence in these capabilities when they design and build greenroofs. I propose to call these socio-biological capabilities phyto-materiality. This becomes both the ends-in-sight vision of (McKenna:2002) and the methodology for, an ecological utopia: ecotopia.

The thesis chapters take the form they do because they reflect my respondent's concerns. For example, policy features centrally because I did not meet anyone who did not believe that there should not be a policy on greenroofs, even if sometimes that policy would be disregarded. The chapters also pay attention to the material culture critique which argues that theorists treat "people-artefact interaction as secondary to processes of culture" (Schiffer 1999:6 quoted in Olsen 2003:88). The chapters move from general to specific, from global to local, eliding divisions between them as they are all in constant dialogue, shifting, realigning, affording. To separate them would be as theoretically problematic as describing affordances as nested (Stoffregen:2000), as if the material leads by levels or stages to the abstract, privileging and supporting the intellectual and mental capacities over material.

This thesis contains nine chapters. Chapter one is a short review of the methodology and some of the decisions made during fieldwork which shaped the final argument. Chapter two sets out the theoretical argument of the thesis. Firstly, I discuss Gibson's affordance theory in relation to material culture studies to argue that the theory needs to be re-evaluated to incorporate plant agency. Gibson denies plant agency based upon the prevailing belief that plants are in-sensate. The second section outlines current biological and ecological theories describing how plants are now known to be sensate and make deliberate choices in their environment. This leads on to the proposition of phyto-materiality as a way of describing the agency plants are capa-

ble of. The literature review then considers the contemporary notions about nature and ecology which inform my respondents. The last section outlines a brief history of governance through the built environment and relies heavily on McKenna's (2002) process model of utopia to discuss how affordances create the ideal conditions for living.

Chapter three introduces a network of greenroofers and some details of how they construct nature, plants and the built environment in London. The title, *Greenroofs afford Greenroofers* describes the central tenant of material culture studies. Persons and the material world construct each other reciprocally (Tilley:1994; 2007). Chapter four describes the materiality of greenroofs and their benefits. Affordances enable plants to thrive and provide greenroof benefits. These are interpreted and described by respondents as ecosystems services.

Chapter five is an examination of Hundertwasser's influence with a case study as a way of drawing out how roofs provide affordances for biodiversity, localism and isolation as the conditions of ecotopia. Chapter six is in depth discussion of the classification and ontology of greenroofs. The process of classification is flexible and fuzzy and this 'superfluidity' (Buchli:1999) has affordances of its own, allowing greenroofers to include and exclude particular roofs according to context. Chapter seven is a discussion of how plants become policy. It outlines the constellations within a policy palimpsest which afford plants and greenroofs to be included in a variety of policy contexts for ecosystems services (ESS). Existing policies become the tools to construct new polices.

Chapter eight outlines how plants realign people. Using an ethnography of a greenroof project, I demonstrate how a local authority team temporarily aligns with multiple agencies throughout London. Climate sceptics, engineers, ecologists and builders are realigned through their consensus over the affordances of one small Alpine succulent. The last chapter brings the themes of the previous chapters together. Case studies reveal how slippages occur between the vision of ecotopia, policy and spacial practices as ecotopia becomes privatopia.

The thesis turns on the capacity for plant agency which is actualised because plants are alive, sensate, growing, changing and agentive separately from humans. These independent capacities underlie and make productive their relationships *with* humans and it is these agentive capacities which my respondents recognise and which, they believe, make greenroofs successful and create material ecotopias.

2

Methodology: The Roofscapes of London

> the attempt to understand another life world using the self – or as much of it as possible – as the instrument of Knowing (Ortner 1995:173).

> London: from the Celtic 'Londinios' meaning the place of the bold one… another interpretation is 'the wild place,' which given the massive urban nature of the city is rather ironic (Frith quoted in Velazquez:2004).

London covers an area of approximately 600 square miles (158,000h) and is divided into 32 administrative districts or boroughs, not including The City of London.[1] My fieldsite, LBZ,[2] is one of these boroughs. LBZ describes itself in documents as a varied borough, ethnically diverse, well educated and with falling crime rates. However, it also has high property prices, above average rents and overcrowding. LBZ houses some of the city's wealthiest and poorest people, some of its most historic and well-loved as well as despised buildings and a wide mix of businesses, residential, heritage, parks and activities. Councils are where different scales of concern and of influence align and coalesce and they aim to have significant local impact. They are "where the

[1] The City of London is administered by the City of London Corporation.
[2] This London borough will be anonymous throughout.

action is" (Bernard 2006:344). This was the reason many of my respondents chose to work at LBZ and why I did too. Simultaneously, the public sector has been highly effective *and* highly contentious. My whole adult life has been punctuated with complaints from every sphere about how unwieldy, and draconian the system is and how incompetent and uncaring council officers are. Surely, this could not be so? Now here was an opportunity to find out.

Participant observation was conducted within an energy and sustainability team in the housing directorate of a London borough authority. The fieldwork experience was in many ways unlike how textbooks indicate it would be. For example, while it was interesting and at times enjoyable, it was not the life changing initiatory experience many anthropologists (Bernard:2006; pers. comms.) claim it should be. Bernard (2006) also cautions that it can take time to be accepted as a member of a group. However, I made contact with my fieldsite with one telephone call followed by a visit to the office. I was immediately accepted into the sustainability team. I had no language to learn, except that of the organisation, and in many ways, I am like the officers: middle class, well educated, knowledgeable and committed to sustainability.

The research was intended initially and primarily to investigate the way sustainability materialises in the interaction between householders and council officers. However, within a week of starting at the LBZ office, it became apparent that all the interesting things were happening on the roof. I immediately dropped a year's worth of anticipation and desk research and started to concentrate on solar PV and greenroofs. There is no anthropological research yet on the way that technologies for adaptation to changing climates within an increasingly dense city are making roofs into newly discovered geographical spaces: roofscapes. That is where I concentrated and started to follow two of the team's projects. Later, it became clear that the thesis write-up should follow only the greenroof.

I conducted two weeks pilot fieldwork during June 2010 and then started participant observation with the team in January 2011. It would be a mistake to believe that workplace relationships are inauthentic. It is these professional relationships which affect change. There is nothing inauthentic about the sustainability team's involvement in the minutia of everyday life in a contemporary, open plan office. We read emails, made coffee, lined up at the photocopier, gossiped, laughed and attended meetings, site visits and afterwork drinks. Officers granted me access to their databases, meetings , conversations and confidences. I followed how they visualised geographic places, interpreted documents, directives, targets and budgets, managed projects and proposed policy changes. I also undertook a content analysis of the official docu-

ments they used and how the layers of local, city and national government, along with international agreements, interweave and interact to produce a sustainability agenda.

While the team were the focus, they held meetings and networked with many other professionals and officers both inside and outside LBZ and so, I got to know and interview other officers in different departments and make contacts in other organisations with whom the team had dealings. In addition, once I decided to concentrate 'on the roof' it became clear that there was a network of possible respondents throughout London and elsewhere who held pieces of the puzzle as to what might be going on in greenroofing. To access these networks, I supplemented my days at the office with networking events, seminars, training courses and interviews with these 'greenroofers' (my term). I attended their seminars, meetings, training courses, walking tours of the city and of roofs, helped to build and plant roofs, conducted interviews and spent many enjoyable hours chatting with people who live and work under greenroofs.

Despite the generosity of the sustainability team, there were many 'places' I was unable to go. In order to be accepted into the council team unremarked upon, during a time of redundancies, I held the position of intern. This gave me a partial, hybrid position which could be easily and conveniently used to deny me access. For example, I was prevented from attending the LBZ carbon management meetings and my request to interview the Head of the Housing Directorate was flatly and aggressively refused. This meant that I attended many informational staff seminars and asked the Head of Housing my questions 'from the floor' rather than in interviews. However, on other occasions the hybrid position provided access to other inaccessible places and shaped the research directly.

Ethnographic fieldwork accounts often neglect the issue of getting on with respondents partly because part of a successful anthropologist's job is reliant on this. I certainly encountered several people who were stressed because of the job insecurity they faced and who interpreted my research as a threat. This became particularly evident when both the solar and the greenroof projects collapsed. Occasionally, social housing residents saw me as a way of circuitously accessing the council systems, bypassing the formal steps, which increasingly did not work for them. As time went on, they regarded me more and more as a council representative, so, after nine months I distanced myself from the council team and followed the projects solely from the householder's vantage point.

The assumption (Cefkin:2009) that organizations make is that any researcher granted

access should reciprocate in some way. However, choosing to work for the team, although this is a particularly insightful methodology (ibid), would have limited me in my attempt to 'follow the project' as discussed by Marcus (1995:106-110). It became evident that my position as unpaid intern was under scrutiny and would have become extremely controversial, leaving the council open to prosecution if I had not laid people's fears to rest about doing the work of recently redundant colleagues.

I also share Brun-Cottan's (2009) concern about the commodification of anthropological methodology and knowledge, especially the advisement of courses of action which negate the individualism which anthropology is so good at articulating. Davina, the new team manager, wanted me to advise the team on how to "make the residents do what we want" and came unwittingly close to the neo-colonial (pers. comm.). I do recognise the possibilities to improve people's work and home environments through ethnographic work, however, this research was not designed to solve problems (Darrouzet et al.:2010). From the start, I resisted working for LBZ, although I undertook many tasks including leaflet design, survey preparation and contract specification design.

In truth, I often found myself in situations beyond my control, always making decisions and negotiating with powerful actors in the field, often wondering when people would get so stressed with the redundancies that they would ask me to leave and seldom feeling I was getting 'the data'. The 'agentive cuts' (Barad:2007) preformed within the thesis are driven by the field site conditions and the data.

Slicing and Networking

"[S]tart from where people are and go with them wherever they take you" was the best advice I could have hoped for (Hart and Ortiz 2008:3). When it became clear that concentrating on roofing projects was going to be a fruitful way of proceeding, I went on a greenroof course, and this led into an extended network of respondents. People leading and attending the course agreed to be interviewed, invited me to events, other courses and introduced me to their contacts. In this way, I was able to network round London counting contacts within five London borough councils, at the Greater London Authority (GLA) and people active in professional and community projects city-wide. After some months, it became evident that there was no more to be gained by making the network wider, so I concentrated on making it deeper.

This type of multi-sited ethnography allowed me to work with many people with dif-

ferent perspectives on greenroofs; collecting 'partial knowledges' and testing them against each other. There was much variation in commitment to ideas of sustainability within all the groups of respondents; from manufacturers, contractors and designers to installers, householders and council officers. Research groups are often separated by profession or geographical location of tenancy (Oudshoorn and Pinch:2003; Yaneva:2009) so one of the joys of following a material culture perspective is the cross-cutting across professional, individual, social and community groups that can be achieved. In addition, I enjoyed the variety which London as a fieldsite has to offer. One day I could be visiting the Chelsea Flower Show, on the roofscape of a skyscraper, or half-way up a rope on a Working at Heights course in a warehouse in East London. The next, I could be chatting over tea in someone's kitchen. While the wide-ranging nature of the fieldsite might seem to be *too* diverse, significant knowledge is gained through both a 'stationary' office fieldsite and an interconnecting, shifting, networked one.

As a resource, I use the American Anthropological Association guidelines[3] (Cassell and Jacobs:2009) and the Association of Social Anthropologists of the UK and Commonwealth statement on ethics (ASA:1999). Employed throughout, are pseudonyms, except a few greenroof respondents who wanted me to use their real names. I thank them for this because a quick Google search would reveal them anyway.

Conclusion

The ethnographic work in this thesis comes from different levels of engagement with three London borough councils. I stayed in the LBZ office for nine months, had contact with LBX intermittently over three months and interviewed officers at LBQ. I still often see and socialise with my respondents and am continually meeting new ones. My ongoing involvement with The Urban Wild Project,[4] a community group seeking to install 30 greenroofs in South London, ensures that there is no definite conclusion to the fieldwork. In many ways, this was an unremarkable fieldsite. Even during the downsizing of the council, officers attempted to resume normality as quickly as possible. This research is informed by more than a year's engagement with a wide number of people in a network sliced through London and beyond, but all tied more or less to the idea that greenroofs are in some way 'a good thing'.

[3] I have also passed the American Institutional Review Board (IRB) examination.
[4] theurbanwildproject.org

3

Affordances, Phyto-materiality and Ecotopia

> we need the notion of affordances to theorize our relationship with material objects since it eloquently captures the mutual dependence between our goals and action, on the one hand, and what the environment can offer us to attain goals and facilitate action on the other (Glăveanu 2012:195).

As Buchli indicates, material culture "is effectively an intervention within and between disciplines; translations from one realm into another" (Buchli 1999b:13). There is no anthropological literature on greenroofs to date and very little social science on the subject. This allows a certain freedom to gather and translate from many sources: architecture, ecology, policy and anthropology. A confluence of influences is drawn together to consider the agency and materiality of plants and greenroofs. While I have chosen affordances and ecotopia, it can equally be said that greenroofs engage directly with other anthropological concerns such as mimesis, cosmology, visibility, landscape, heterotopias, network theory or the development of new ecological aesthetics. I do not disagree. They simply remain potential futures-in-sight.

James J. Gibson's affordance theory is foundational to, and underpins material culture study theories of agency (Bloomfield et al.:2010; Ingold:2010; Latour:2005; Tilley:2007). Affordances matter because they create the conditions for agentive

capacities to operate. Agency theories have started to de-centre the human, in order to account for how other material (Barad:2007), animal (Haraway:2007), plant (Jones and Cloke:2008) or multispecies (Kirksey and Helmreich:2010) capacities are interacting with, shaping and impacting human sociality. Ironically, this comes just as, or even because, humankind is entering a new era; the anthropocene (Crutzen and Stroermer:2000), so named in recognition of the human causes of climate change.

By re-examining affordance theory in light of the advances in biology and ecology and through a material culture framework, it can be shown that plants demonstrate agentive capabilities. These agentive capabilities are recognised and employed by my respondents in order to create new urban ecological habitats. In rethinking affordances, I call the material culture of plants *phyto-materiality* in recognition of the fact that they are biologically alive and agentively capable, even when they are not entangled with human sociality. The bundling of affordances, framed by my respondents as ecosystems services (ESS) influence and shape the creation of ecological habitats; changing roofs to roofscapes. The vision of the greenroof movement is the creation of an ecological utopia: ecotopia. This is not an anticipated, 'not-yet-conscious' (Bloch:1986) future, but a pragmatic process of working within organisations and limitations to position greenroofs as a solution to the governance of multiple concerns within London's changing climate. Phyto-materiality is both the vision of how London (and in turn, all cities) could and should look as well as the means of attainment.

Affordance Theory: An Ecological Account

From Morgan (1868), through Durkheim (1912) and Bateson (2000) to White and Steward (1977), many anthropological theorists have found organic and scientific models (Dove and Carpenter:2007; Moore:2012; Haraway:1991; Franklin:1995; Barad:2007; Lansing et al.:2006) useful in order to "think the unthinkable" (Dove 2001:71). However, despite this there has been little rapprochement between the ecological and the social sciences (Lansing et al.:2006; Biersack:1999). Ecological and ecosystems theories seem unable to incorporate humans without objectifying and quantifying their role. Human exceptionalism (agency, symbolism and culture), which the social sciences claim means: "[c]ultures and ecosystems are not directly commensurable" (Rappaport 1990:52). When social scientists place humans in their environment they become susceptible to accusations of anti-humanism or environmental determinism. Gibson's affordance theory can provide a bridge between these disciplines.

James Gibson (1904-1979) developed the theory of affordances in an attempt to dis-

lodge the (then) prevailing mechanistic view within psychology which postulated that any visual information from the environment was indirect or mediated; processed by the brain before recognition through a system of cultural representations (Withagen et al.:2012). "The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (Gibson 1986:127). Gibson regarded affordances as 'inherent potentials' in the material world, an idea which emanates from Jacob Von Uexküll's (1921) notion of *umwelt*, which Favareau defines as:

> a biologically instantiated and causally efficacious set of agent-object relations reducible neither to the organization of the subject nor to the organization of the environment but always as the product of the interaction between the two (2010:83).

These inherent potentials in the material world develop from Aufforderungscharakter, 'invitation character' or 'valence' as used by Kurt Lewin (in Gibson 1979:138; see also Heft:2003). Affordance theory has become a central concept of ecological psychology (Stoffregen:2000; Heft:1989, 2003; Gibson:1966, 1986). The theory has been useful to many disciplines: design (Norman:1998), the health sciences (Roe and Aspinall:2011) and music theory (Schiavio:2012; Windsor and de Bezenac:2013) with some of the most interesting and valuable insights from archeology (Knappett:2004; 2005; Knappett and Malafouris:2008) and anthropological approaches to technology (Suchman:2006). Affordance theory turns on two notions: direct perception and action possibilities (Gibson:1977).

Direct Perception

Gibson suggested that affordances are always perceivable because they are located firmly within the material: medium, substance and surfaces. "The object offers what it does because of what it is" (Gibson 1982:139). Affordances "do not cause behavior but constrain or control it" (Gibson 1982b:411). This has led some to an instrumental view of affordances as 'regulators' (Reed:1996) of natural selection in response to scarce environmental resources, or as von Uexküll (1921) argues (pre-Gibson), acquired qualities or add-ons. There has been some debate on whether ecological niches are separate to, *a priori*, or constructed by, an animal. Gibson indicates that animals

and humans[1] inhabit already existing and separate ecological niches. Remove the animal, and the niche remains.

This leads Stoffregen to call affordances 'environmental resources' (2000). Edensor (2005a) also calls them resources. Withagen et al. (2012) also follows Gibson's original formulation. However, others see a more reciprocal relationship where animals develop their environments, shaping them to their own needs. Suchman (2006) and Bloomfield et al. (2010) demonstrate how affordances can be designed and built-in to an environment, such as a computer or as this thesis demonstrates, a greenroof. This leads Croll and Parkin to argue "the tree is not part of the environment *for* the squirrel, it is part of the environment *of* the squirrel" (Croll and Parkin 1992:41).

Others describe affordances as permanent, only interpretation or the needs of the animal change. "Something that looks good today may look bad tomorrow but what it actually *offers* the observer will be the same (Wilson 1982:410 quoted in Withagen et al.:2012 emphasis in original). Sutton (2008) disagrees, describing how affordances can be temporary. In addition, an object's possible use is not always obvious from visual (or other sensual) examination and can be historically or culturally obscure. Someone not familiar with greenroofs, for example, may not know or see that they are attenuating water, absorbing air-borne particulates or insulating the building. For another person, placing stones and soil on a roof may make no cultural sense at all, even if the result is recognised through the category of 'roof'.

Turvey (1992), Warren (1984) and Michaels (2000) all argue that affordances do not exist independently of an observer and Chemero (2003) proposes that affordances depend on a *potential* observer. For Turvey, an agent must possess 'effectivities' (1992) to perceive and employ an affordance. If, however, a stone only affords sheltering when a bird requires it, this reduces affordances to 'dispositional properties' because they appear only under actualizing circumstances. They can not be dispositions, for as Chemero states: "coupled with the right enabling conditions, dispositions are guaranteed to become manifest" (2003:189). For instance, sugar *always* dissolves in water under suitable conditions because of the laws of physics. However, by contrast, affordances may fail at any time. When Sanders (1997) argues that affordances must be ontologically complimented or completed by effectivities, he does so from a position of dislocating them from materialism and calls them 'ontological primitives' as opposed to the 'dispositional properties' of other things such as materials or objects. Using the colour red as an example, he argues that redness cannot be an affordance

[1] It does not help that Gibson is inconsistent when using animal/human examples and this affords occasional confusion.

because it depends upon an object for its existence. However, as chapter six will show, the natural colour of certain plants may afford a belief that the plants are sick or dead. Brownness may also allow movement of one type of greenroof into a separate, more privileged category. In certain circumstances brown behaves like an affordance.

Norman (1998) differentiates between perceived and actual affordances to describe how the material can confound the category in terms of the affordance.[2] An object made of glass affords smashing while replacing it with ply board does not, although the amount of force required for either act of smashing is identical. This, he speculates, may depend on other affordances such as seeing through. This point will re-surface in chapters five and nine when respondents attempt to use nature as a rehabilitating force for the built environment. Knappett suggests: "[p]erception in the course of situated action is direct and indirect, mediated and unmediated and in terms of embodiment as well as representations" (2005:49). "It is as if humans interact with objects using two enormously different logics simultaneously, the one linguistic, codified and symbolic, the other embodied, uncodified and pragmatic" Knappett (ibid:49). Gell calls this structural isoporphy: "the cognitive processes we know (from inside) as 'consciousness' and the spatio-temporal structures of distributed objects in the artefactual realm" (Gell 1998:222).

Relations and Emergence

Gibson always intended to problematise the object/subject divide: "it is false to put into opposition the contribution of the perceiver and the contribution of the external stimulation" (Gibson 1982:234). The relationship is one of 'reciprocity'.

> An affordance is neither an objective property nor a subjective property; or it is both if you like …[It] points both ways, to the environment and to the observer (Gibson 1979:129).

Turvey (1992), Warren (1984) and Michaels (2000) agree with Knappett, who follows Gibson on relationality:

> The affordance of an object is neither solely an independent property of the object itself, nor is it exclusively an intentional state within the mind of the person engaging with it, but a *relational property* shared between object and agent (Knappett 2005:46 my emphasis).

[2]See also Harvey (1986) who uses 'observe-ability' and 'percieve-ability'.

Sanders (1997) describes the interaction between objective and subjective as interactive, fluid and in flux. This has led some to propose that events are "changes in the layout of affordances" because affordances are "*relations* between the abilities of organisms and features of the environment" (Chemero et al. 2003:189 my emphasis). Two people can see an affordance in a greenroof, but because they each have a different personal relationship with it, that affordance can not be located in the environment alone. It is a property of, and emergent from the relation each person has with the greenroof (chapter eight).

For Stoffregen, affordances are linked and nested: change in one affordance can alter a whole system of affordances and their effects. He argues that:

> affordances are *properties* of the animal–environment system, that is they are *emergent properties* that do not inhere in either the environment or the animal" (2010:115 my emphasis).

Chemero counters with: "affordances cannot be properties, or even features, of the environment alone" they are "features of whole situations … belonging to animal-environment systems" (2003:185). Grechkin et al. (2013) describe them as *negotiated* between a subject's action capabilities and the affordances of the environment and Hicks argues:

> Objectification or subjectification requires work; such processes must be made to happen and maintained. Thus, things are always events—more or less visible depending on the constant changes in the human and non-human world (2010:84).

I view this disagreement in terms of Gibson's own uncertainty and developing theory.[3] Initially, he describes animals as active in relation to affordances, 'looking for' them, later he suggests affordances are emergent and still later, reciprocal.[4]

Tilley (2007) and Miller (2007) take the relational view of affordances, the material world mutually shaping sociality. For Tilley, following Merleau-Ponty (2002 [1962]) the physicality of the object, the desire of the acting subject, positioning of the body and the process of action, act in concert to produce an event. Heft (1989) also takes the phenomenological position and agrees that there must be an embodied relationship

[3]Later in his career, Gibson is more deeply reflexive about his theory. Others, standing on his shoulders, have developed a language and grammar to assess affordances.

[4]Costal (1995) refers to early and late Gibson.

between affordances and the agent. Affordances are changeable, dynamic (not active) meaning that it is the situation, not solely the materiality nor cognitive function which determines an affordance. As Heft cautions, (1989) the number of affordances is not limitless. There is also only so much you can do with a greenroof, or as Steward puts it, there is "more than one way to skin a cat but if your only tool is a bamboo sliver, there are not many" (Steward 1977:22-23).

Action Possibilities

What everyone does seem to agree on, and with Gibson, is that affordances are relative to the animal. They are "stimulating, in the state of offering, prompting action, producing an effect in order to distinguish themselves from merely physical qualities" (Gibson 1986:127). The greenroof may possess physical qualities such as stony ground or cool shady areas, but these are merely physical qualities. They offer birds, animals and invertebrates the affordances of sheltering, protecting or nesting. There may be a surplus of affordances provided by one object or environment or different qualities of one object many afford different actions. A rock on the greenroof can provide sheltering for one bird or breaking (a snail shell) for another, or indeed for the same bird at different times. For the human, the rock may afford throwing or breaking (a nearby window). Affordances may not always be 'available' even to an agentive actor/animal or they may choose not take advantage of the affordance (Knappett and Malafouris:2008). The rock may fail to provide sheltering or the animal may choose to run rather than hide and in both cases, its predator may kill it. Further still, the consequences of the uptake of an affordance may be unintended (see chapter nine), or the affordance can be deceptive or become visible unexpectedly. A roof may have a crack that is invisible to the naked eye but when it rains, it will afford leaking. This leads on to a further point. Affordances are not positive, or negative. They simply afford.

Intentionality, Agency and the Social

For Gibson, the environment is composed of neutral objects and this neutrality requires intentionality from the animal/agent. When it comes to human agents the reactivity and the passivity that many arguments on affordances imply become problematic. Conein and Jacopin (1993, in Knappett:2004) suggest that observers (humans)

can be active (in evaluation) *and* reactive (in execution) when discussing kitchen spacial arrangements (See also Knappett:2005).

In 2007, the journal *Archaeological Dialogues* devoted an issue to the ongoing dialogue between Danny Miller, Chris Tilley and Tim Ingold; a debate about agency and sociality to which Carl Knappett has recently been contributing. Ingold's discussion article, to which the others respond, proposes that things are "active not because they are imbued with agency" but because material and their properties "are not fixed attributes of matter but are processual and relational"(Ingold 2007:1). The nub of the disagreement is the extent to which the object/subject is dismantled by each claim. Both are informed by affordance theory, although the point of departure for Miller is Hegelian dialectical objectification, for Tilley it is phenomenology derived from Heidegger and Merleau-Ponty, whereas Ingold insists on a Deleuzian notion of process.

Both Ingold and Tilley use a phenomenological framework to examine the experience of being-in-the-world, however, Ingold's (2007) complaint is that Miller and Tilley kill objects, freezing them in time in order to think with them. For Ingold's example of a stone as part of the fabric of the mountain, its present location, on his table, is only one instance in its journey to the sand it may become in another 10,000 years. Tilley agrees that the stone has many material properties and that this "brute material" can be measured empirically (2007:17). However, some of the properties of material objects also enable the creation of meaning and significance for humans, and when objects do this a post-empiricist theory of materiality is required.

> the concept of materiality is all about going beyond the stone itself and situating it in relation to other stones, landscapes, persons and their doings – in other words developing a holistic and conceptual theoretical and interpretative framework" (Tilley 2007:18).

So in a sense, Ingold is looking at material culture along a vertical axis of ongoing time and process, Tilley along the horizontal axis of material as socially embedded and which is expansive enough to include time, process and power. It is Ingold, therefore, who has to freeze objects in time to examine them.

For Tilley and Miller then, the material world is not of interest if it does not become socially embedded and therefore, anthropological. This leaves the problem of what Soper calls 'realist nature' (2011); separate from humans but to whose laws humans are subject. Tilley describes this nature as 'base materials' (2007), and like Salisbury (2012) and Bender (1999), does not recognise any part of it agentive. These

theorists claim that it is only through human involvement with a substance or object that agency and material culture can be achieved. Tilley further argues that the relationship between affordances and agents is a relationship between objects, animals or plants and people. Agency involves "providing affordances and constraints for thought and action" and later, as "(effects) of things on people" (Tilley 2007:19). As discussed however, affordances are neutral and their opposite is not constraint.

Material culture studies is predicated upon the notion that the material world co-creates the social. In fact, Miller goes further by suggesting, "material culture matters because objects create subjects much more than the other way round" (Miller 2009:287). Miller and Tilley (2007) insist this relationship therefore, does not, can not, exist without the human social. Knappett also recognises affordances only when embedded in the social[5] and Chemero suggests that objects have an ongoing physical life which must be disrupted and "precipitated out from the generative fluxes of the medium that gave birth to them" (2007:5). These viewpoints stem from the 17th century mechanistic view of primary (external, or independent) and secondary (internal, subjective) characteristics (Withagen et al.:2012). The primary qualities of the material world exist externally to the acting subject, but it is the secondary qualities which the acting subject holds which give meaning to the environment. Instead, Gibson argues, the environment is full of meaning, enabling choice, interaction and agency. Animals (human and non-human) take up affordances in their environment, and no sociality is necessarily implied in that process.

As Chemero, following Gibson, states: "affordances produce the conditions for and the possibility of agency" (2003:189). Others theorise agency extended outwards from humans (Gell:1998), transferred to objects (Dant:2004) or achieved through extended networks (Latour:1993).[6] Peircian semeiotic synechism of performance, comparison and thought (Hodder:2012; Watts:2008) however, disrupts this neat anthropological relationship. Peircian semeiotics is a pragmatic phenomenology in which the sign is not arbitrary and dyadic. There is a mediation between object-sign-interpretant, where the interpretant is the referent and is also the character of representation itself (Watts 2008:190).[7] The idea that the interpretant need only be formed and need not be

[5]He does not make it clear whether he is arguing that all animals (and plants) possess sociality, or if this is not the case, how then can affordances only exist only for humans.

[6]Actor Network Theory's "material semiotics disentangles agency from intentionality" (Law and Mol 2008:58) and relies on a synchronic and diachronic model of signification. The sign is relational and exists within a context or background, stemming from de Saussure's semiology, where these relations between signifier (word) and signified (meaning) are arbitrary.

[7]Firsts' are possibilities; 'seconds' are actualities and 'thirds' are what take the possibilities and actualize them. Firsts can not be separate from seconds e.g. colour (a first) can be abstracted, but not exist outside of an object which actualizes it. Firsts and seconds can not be extracted from thirds

attached to a brain means: "thought is not necessarily connected with a brain. It appears in the work of bees, crystals and throughout the purely physical world" (Peirce 4.551 quoted in Watts:2008). All signs display agency because they act as interlocutors.

Peircian semeiotics makes clear how the displacement of meaning from mind, from human-kind is possible. It provides the ability to construct a theory of non-anthropocentric agency. Karen Barad (2007) deftly de-centres agency in her theory of agentive realism which accounts for the agency of the physical world, the things Tilley dismisses as 'base materials'. Theoreticians of biosemiotics (Barbiere:2007; Favareau:2010) also propose that the biological world is not just physical and chemical but informational. They draw on the same theoretical basis as material culture: von Uexküll's biological perspective, Peircian semeiotics and Gibson's affordance theory to reach many similar conclusions, coming from different disciplines.

Affordances and Plant-life

The comparison to humans, especially in terms of movement, sensation detection and communication has been particularly detrimental to plants. Gibson regards them as *a priori* and necessary for animal life, but little more:

> The environment of plants, organisms that lack sense organs and muscles, is not relevant in the study of perception and behavior. We shall treat the vegetation of the world as animals do, as if it were lumped together with the inorganic minerals of the world, with the physical, chemical, and geological environment (1986:7).

Gibson is uncritically[8] reproducing the classification which has assigned plants to a lowly status since (at least) the Greek philosopher, Porphyry of Tyre (c.233-c.309, BC), whose schema for taxonomy is based on a formula (*definiens*) of inclusion (within a genus) and exclusion (*differentia*).

which are experiences, or the interactions between them. In the 'triadic relations of performance', firsts are icons, connecting object to sign through mimesis, seconds are indexes and bear a deictic relationship between object and sign (smoke/fire) and the third, is symbol (e.g. language) relating object to interpretation by convention. The three can not be separated.(closely follows Watts' 2008 explanation).

[8]He is also making a strong and quite revolutionary argument for the 1950s, so ignoring the inconvenient complexity of plant life is understandable. In addition, the scientific evidence for sensate plant life had not been completed.

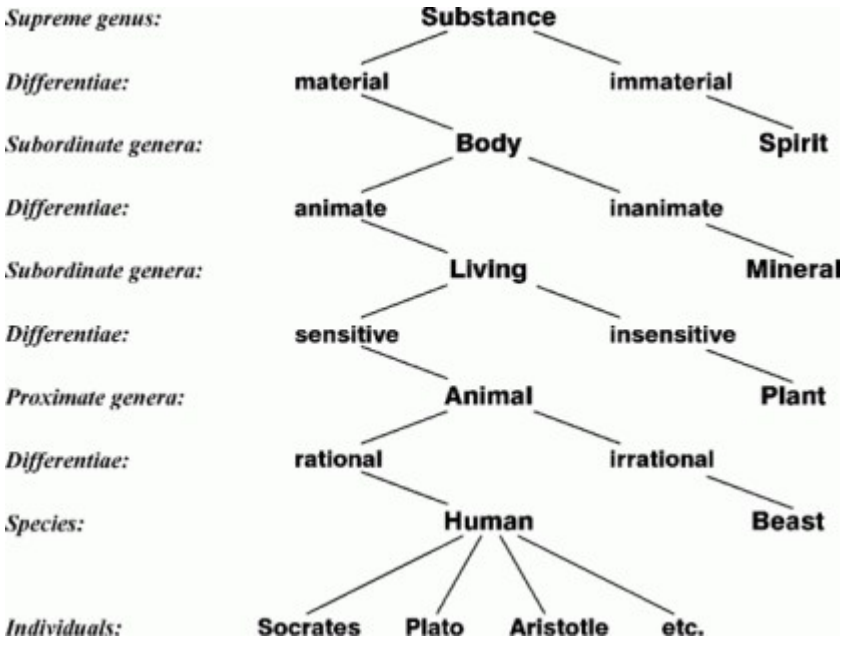

Figure 3.1: Diagram from online philosophy course at the University of Washington (Cohen:2007).

Plants = $_{df}$ substance material animate

where as

Humans = $_{df}$ substance material animate sensitive rational

A schema, constructed circa 520 AD by Roman philosopher Anicius Manlius Severinus Boethius,[9] similarly constructs plants as insensate (Mind Mapping Blog:2013). This taxonomy went unchallenged by Immanuel Kant who considered animals merely instinctual, lacking in intentionality and creativity; although, natural, ontologically whole, growing and self-reproducing (Soper 2011:4-5). Gibson follows Kant:

> an organism such as a tree is an attached object in the environment of animals since it is rooted in the ground like a house with foundations, but it is a detached object, a whole organism, when considered as a plant with roots between soil particles (1986:34).

This lowly status survives through the 19th century where the unilineal line of evolutionary progress entrenches them firmly with "[r]ock, soil, sand, mud, clay, oil, tar, wood, minerals, metal" as "examples of environmental substances" (Gibson 1986:19). Gibson does allow plants some chemically based activeness as they "change their

[9]Jean-Baptiste Piggin reconstructs these taxonomies based on what he calls 'reliable' copies of the original manuscript *In Isagogen Porphyrii Commentum* (Piggin:2013).

color and texture with the seasons of the year" (1986:105). These changes are "significant" because they reveal ripening berries and flowers which afford feeding for animals (1986:110). However, his argument centres around the plant as background 'base' material for animals. Favareau blames Jaques Loeb the German-American biologist who coined the word 'tropism' to describe movement/performance, thus turning "all living animal subjects into nonliving machines that arrange themselves separately in space" (2010:96). One could easily include plants here.

These classificatory systems employing the human as standard or ideal have systematically explained and ordered living things in relation to each other. The lower status of plants has generally been taken for granted, based as classificatory systems are, on difference. Plants are thought to lack three criteria: brains/nervous systems, muscles for movement and communicative organs, thus rendering them insensate, stationary and uncommunicative (Gibson 1986:7). However, in the past decade, biologists have rediscovered Darwin's (1880) investigations into plant sensory abilities and have started re-examining the scientific evidence for these claims (Chamovitz:2012a; 2012b).

Current evidence shows that plants are sensate in different ways than animals (ibid). They detect light through photoreceptors in their shoot tips, measure the length of night/darkness[10] and can detect a greater range of electromagnetic waves than humans. Their phytochromes (colour receptors) can differentiate between red and blue and red and far-red. Where humans have four photoreceptors, arabidopsis (Arabidopsis thaliana) has at least 11, of five distinct types, which signal the plant to germinate, bend in light, flower and recognise night-time (for an overview see Franklin and Quail:2010). Plants are also sensitive to hot and cold, which allows them to alter their growth, reproduction and control their water responses. Some plants (e.g. the dodder) detect or 'smell' sugary sap from other plants, actively choosing to grow towards them. They can also detect and avoid unhealthy plants (Runyon et al.:2010). Plants can also detect touch (Braam:2005) and exhibit a variety of responses including retardation or stimulation of growth. The venus flytrap, among many plants, also exhibits memory.[11] Touch can also alter the genetics of a plant and the resulting changes be passed on to the next generation, a reinvigoration of the, until recently, discredited Lemarkian acquired characteristic theory.

[10]Useful for the floristry industry which uses periods of darkness in order to retard and stimulate flowering.

[11]Triggering a sensate hair releases chemicals which last for 20 seconds before degradation. If the insect triggers a second hair within this time the chemical threshold which shuts the trap is exceeded. This ensures the insect is large enough to warrant the chemically-expensive action. John Burdon-Sanderson at UCL, a contemporary of Darwin's, discovered this mechanism.

Plants respond to gravity (Franklin and Quail:2010). Beans (*Vicia faba*) can upend themselves if placed 'upside down'. Although plants can detect and respond to sound, they do not exhibit a preference for classical over heavy metal music, as Retallack (1973) attempted to claim. Plants communicate from leaf to leaf and from plant to plant (Kessler et al.:2006) via airborne chemical signals (Chehab and Braam:2012). Phytochromes "perform a major role in the detection of neighbouring vegetation and initiation of escape responses" (Franklin and Quail 2010:16). They also communicate with neighbouring plants through their root systems via symbiotic fungi (Babikova et al.:2013). When under attack by insects, plants can chemically communicate this to enable neighbouring plants to adopt a defensive chemical reaction which makes them less attractive to predators. Ethylene emanating from ripe bananas stimulates other nearby fruit to ripen. Gagliano and Renton (2013) found that some plants, like chilli peppers (*Capsicum annuum*), sense and recognise 'good neighbours' such as basil (*Ocimum basilicum*) and seeds germinate better in their presence.

Plants display decision-making capabilities and intention by responding to the signals they receive from their environment. The visual, chemical and genetic signals they receive are translated into "physiologically recognisable instructions" (Chamovitz 2012b:28). By drawing the research together, Chamovitz argues that at the level of perception, plants are biologically and chemically more sophisticated than animals, including humans. However, not all agencies are equal. Animals and plants do not have the same agentive cognitive capabilities, self-reflexivity, control and creativity as humans (Haraway:1991; Law and Mol:2008). None of the biological scientists, least of all Chamovitz, is claiming that plants are as agentively capable as animals. However, it can be recognised that they are differently agentive because they are differently afforded.

Genetic change, as de Landa (1994) and Ingold (2000) note, does not always equate to behavioural or physical change and vice versa: "the genome, on its own, does not specify a capacity of any kind" (ibid:387). In order to explain this, Ingold suggests, the biological sciences have had to separate evolutionary history from cultural history, so by realising:

> that capacities are constituted within developmental systems, rather than carried with the genes as a biological endowment, we can begin to see how the dichotomies between biology and culture, and between evolution and history, can be dispensed with (2000:385).

As de Landa (1994) suggests, bird behaviour is both genetic *and* choice. When thinking through affordances, the self awareness, intentionality and agency the non-human world exhibits have been ignored, underplayed or grossly simplified. Animal behaviour has largely been attributed to instinct or genetics, thus denying animals the capacity for agentive behaviours.

Phyto-materiality

Material culture, as the study of the significance of artefacts, objects and things to human sociality tends to choose what Hitchings describes as "inert" and "fairly docile materials" (2006:364, 366). These objects of study are generally man-made items such as jeans, photographs, memorials, etc. While they ignore, interact, influence, modify, pushing-back, define and reciprocate, they do so because humans are at the heart of their production, circulation, exchange, destruction and reinvention. This gives the impression of agency as a human quality which can be imparted to objects or abducted from objects back to the human subject/creator (Gell:1998). Plants exhibit more than this kind of reflective agency. While they have historically had many important relationships with human sociality: agriculture, markets, consumption and metaphorical meaning, they are also discrete, ontologically complete entities which are biologically alive, possessing vitality, they demonstrate agentive capacities. While they are greatly entangled within human sociality, they also exist independently from it.

These qualities need to be recognised in order to appreciate fully their material culture and I use the notion of phyto-materiality to indicate this. Other terms, such as 'biomaterial' are ambivalent because they can mean biologically produced materials such as eco-fuels (Reno:2011) or materials used to interact with or control living systems (Williams:2013). Phyto-materiality is *alive* and there should be a recognition of this and the creative and productive agentive capabilities this enables. Plants have their own lives, agencies, capacities and life-worlds, independent of humans and this is a quality which jeans, plastic, advertising or books exhibiting a Gellian second order agency, extended from the human to the human-made artefact, do not possess.

Plants exhibit these capabilities to be agentive and more-over they are capable of this even when no human is present/observing/entangled or otherwise engaged with them. Their sensate existence, their ability to be decisive and their agentive capacities (but always remembering that they are not equal) require a theory of materiality

which accounts for these. Developing models of ecology and climate change show that all life connects in unexpected ways of which we were previously unaware.

Material culture perspectives on plants tend to group them into spatially defined collections, such as gardens, parks or landscapes (Tilley:2008; 2009). These are often supplemented with non-human features such animals, humans and benches, waste paper baskets and ice cream vans. However, it is the plants which are integral to the definition. Paul Cloke and Owain Jones, for example, discuss "how the nonhuman agencies of trees contribute to the (re)production of nature-society relations and place" (2001:249). Orchards constitute place and are active within it and within human social networks. Each tree is an individual and requires individual treatment, so the pruners regard their work as scientific, craft and art form. Even though the trees are replaced regularly with new specimens or varieties, there is a unity which holds "the ongoing orchardness of the orchard" (ibid:658).[12] Older tree-tending processes combine with new and contemporary technological ones in a way which is unproblematic for the workers but raise issues for the theorists who worry about concepts of authenticity, landscape, being-in-the-world, technology and ultimately, dwelling. Cloke and Jones do not make a human/non-human separation: this is a life/non-life split, speaking to a Western ontology where living and non-living beings exhibit difference. How this influences greenroofs is explored more fully in the thesis chapters.

Andrew Garner (2004) describes how trees remind his respondents of the scale of time, both past and future. People use old tools and the lifecycle of trees means that many people will not live to see the results of tree planting in the present, reinforcing how phyto-materiality exists independently of the human. Planting trees is about leaving a mark for future imagined others. Alfred Gell's self-confessed environmental determinism (1995:252) proposes that the Umeda of Papua New Guinea privilege sound over vision to construct culture and that the forest contributes to this specifically by "a reorganisation of sensibility" (1995:235).

There have been several attempts to describe the variety of increasingly recognised inter-species relationships. Wolch et al. (1995) develop a 'transspecies' framework to incorporate nonhuman agency and the way that plant and animal flows and networks transverse the cityscape, imbuing it with character and vitality. Harvey et al. describe tomatoes and bees as "bio-socio-economic varieties" (2002:118). Kirksey and Helmreich use the term biotic[13] materiality to describe the large variety of living others such as plants, animals and microbes which are encountered by humans: "[c]reatures pre-

[12] Like the Shrine of Ise (Tokoro:2001).

[13] Biotic: "relating to or resulting from living organisms from … bios 'life' " (OED:2013a).

viously appearing on the margins of anthropology" and "confined in anthropological accounts to the realm of zoe or 'bare life' " (2010:545) (see also Adamson:2011). Berrigan's (2009) work describes her circular relationships with the Hepatitis B virus and dandelions (*Taraxacum officinale*). Tired of hearing her infection described through war metaphors, she describes herself as carrying the virus and takes the herbal remedy dandelion root, commonly thought of as a 'weed', to help strengthen her liver. She notes that her blood is infectious to humans but can be food for the soil. She uses the term 'microbiopolitical' giving voice to the entanglements and interactions of virus, plant and human, reminding us that current, prevailing or mainstream attitudes always have the potential to be re-interpreted (ibid:560).

Introducing a notion of phyto-materiality is not reinventing the wheel but adding complexity by recognising two things. Firstly, agency is not a single human characteristic, possession, attribute or power, but emergent as Barad suggests, in "the ongoing reconfigurings of the world" (2003:818). Secondly, plants are alive. These living materialities still have significant entanglements with human sociality but, following Gibson and Peirce they also possess agentive capabilities which are independent of human sociality. The greenroof is a humanly constructed artefact, but it provides the affordances for the ongoing reconfigurations of animal, bird and plant relations. This allows a complex web of biodiversity to develop. These independently agentive configurations of biodiversity are what respondents recognise and rely on. They occur between the flora, fauna and the physical conditions of the greenroof whether there are people present or not. Respondents know and recognise that these independent capabilities which plants possess allow them to elide definitions, enabling greenroofs to be natural and unnatural simultaneously and to move from one state to the other. Each greenroof, always and without exception depends upon the plant-life for its ontological stability.

Anthropology and Responsibility

Arguing that plants possess their own material, genetic, chemical, sensate and social existence separate from the human begs the question: how is this anthropological? Bluntly, global climate change makes everything anthropological. The recognition that human activity has greatly altered the biosphere and continues to alter climatic conditions means that humans have a responsibility to develop an ethics of care for the environment (Barad:2007).

Since Lewis Henry Morgan penned his attack on the treatment of beaver in America:

"[w]e deny them all rights, and ravage their ranks with wanton and unmerciful cruelty" onwards, the discipline of anthropology has been concerned with an ethics of nature and human relationships (1868:281–282). As a feminist, Karen Barad (2007) is concerned to include an ethics of care within her theory of agental realism and this only serves to highlight the way Gibson (1982) neglects care and responsibility when he describes affordances as a neutral field. He concludes that the observer is a moving, interacting actor, not acting from a series of photograph-like pictures onto which the world is mapped. However, people do not look at environmental issues dispassionately (Milton:2002; Basso:1984; Carrier:2003) and my respondents certainly do not. Susan Clayton and Susan Opotow (2003) try to express and nuance the relations between emotion, nature, identity and sociality, by recognising the ways that people construct nature and at the same time how it informs and becomes part of their identity. Nature is unstable, shifting and contingent but in the end, they conclude: nature is moral (ibid:14). Nature is not moral any more than ecosystems are offering their services (Hornborg 1996:57). However, my respondents proceed as if Nature were external and moral, because this enables them to think through things, and make claims about existential threats, ways of living and 'saving' the earth from a changing climate. They take part in and extend the political debates on the environment using these physical and emotional claims, something Milton (2002) demonstrates for her respondents. As Taussig argues, "culture externalizes its social categories onto nature, and then turns to nature in order to validate its social norms as natural" (1980:33).

Affordances do not produce something, but enable action and nature does provide the affordances for the construction of a moral field. Harper et al. (2008) suggest that something like intelligence is never a quality of things or objects (as in smart homes, smart meters etc) but enabled by the material world. Later Gibson[14] describes affordances as both physical and mental, contained in values or meanings (1982:129). Costall (2007) suggests that when objects with affordances are produced, their meanings and uses identified, they are explained, managed, policed, and enforced. Affordances, like nature itself become a moral field populated with actors who attempt to control and enforce meanings and this thesis will meet some of those actors on their own terms.

[14]Costall also recognises 'early' and 'late' Gibson when he tussles with cultural relativism meeting the reality of the affordance in the world and tries to reconcile them differently at different times (1995).

Literature on Greenroofs

Greenroofs, as a response to climate change, are both the method of mitigation and the end view of adaptation. There is a burgeoning literature: on greenroof design (Peck and Kuhn:2011); construction (Gedge and Little:2013; Newton et al.:2007); planting (Dunnet and Kingsbury:2010; Snodgrass and Snodgrass:2006) and policy implications (Lawlor et al.:2006; GLA:2008; Waldbaum:2008). In addition a small, but growing number of research centres at universities in London, Sheffield, Zurich, Philadelphia and Haifa in Israel have been set up. They investigate the physical qualities of greenroofs: the most effective substrate layers and plants; water attenuation; energy conservation; biodiversity and effects on different populations of invertebrates, bats and birds.

Respondents suggest that there is too little research into roof longevity and the psychological and health benefits of greenroofs. They are keen to establish positive links in order to strengthen policy claims. Respondents research and refer to psychological studies which claim that having access to, and being in, green places is psychologically beneficial (Roe and Aspinall:2011; White and Gatersleben:2011). Ulrich (1984) claims that access to green vegetation could reduce hospital convalescence time, and Paevere (2008) argues that plants could improve workforce productivity. Tzoulas et al.'s (2007) review article demonstrates how green infrastructure (GI) could contribute positively to human health and wellbeing. The Woodland Trust has recently contributed to this research claiming savings for the NHS of "£2.1bn a year if everyone had access to green spaces" (Kinver:2013). Research becomes incorporated within the project of greenroof policy-making and funding bids (chapters four, five and nine).

There is a total lack of anthropological focus on greenroofs and the social science is scant. Yuen and Nyuk's (2005) survey into resident perceptions of rooftop gardens in Singapore confirmed that people enjoy them aesthetically and recreationally. By far the most attentive social science on greenroofs comes from the geographer Jamie Lorimer who works with interspecies encounters in urban ecosystems (Francis et al.:2012; Lorimer:2008; Lorimer and Davies:2010). His early, 2008 article on greenroofs proposes a Deleuzian inspired fluid biogeography placing greenroofs firmly within a framework of wildlife conservation.[15] This focus gives the impression that greenroofs are in a utopian state of becoming where anything is possible. However, as chapter four demonstrates, greenroofs are a highly pre-scripted material form which

[15]Dusty Gedge, one of his interviewees characterised it this way in the early 2000s.

is very tightly controlled and regulated. They cannot develop open-endedly. Respondents who are experienced ecologists and botanists can accurately predict the kind of insects that certain plants will attract and the kind of ecosystems which will result.

Lorimer's later work (Frances et al.:2012) re-situates greenroofs within reconciliation ecology (RE). RE was developed by Michael Rosenzweig in the early 1980s and is defined as "the science of inventing, establishing, and maintaining new habitats to conserve species diversity in places where people live, work, or play" (2003:194). It comes out of species-area relationships (SPARs) which describe mathematically how the number of species (diversity) of plants depends on area.[16] RE "addresses the new, sterile habitats in which most species cannot function at all. It brings them back to life" by understanding and providing affordances to enrich the man-made environment enabling animals and plants to be agentive and thrive (Rosenzweig 2003:203). For example, the large grain growing prairies of the US, devoid of features also became devoid of loggerhead shrikes (*Lanius ludivucuanus*). By understanding that the birds hunt insects from branches, ecologists introduced posts into the prairies and the bird population increased. This reduced the need for insecticides because the birds were able to hunt and reduce the insect populations (Yosef and Lohrer:1995 quoted in Rosenzweig 2003:203). Human-made or human-altered habitats become reconciled, more species friendly and diverse. Conservation and preservation are not sufficient strategies, Rosenzweig argues, because they rely on an imagined previous state of nature, and because they resist change and the causes of the ecological crisis (ibid:144).

Classifying greenroofs as Reconciliation Ecology is still troubling, however because most respondents do not identify what they do as RE. Only one respondent ecologist confirms that a greenroof: "[d]efinitely meets the definition of reconciliation ecology if designed for biodiversity and not just a pleasure or aesthetic garden" but he does not identify his work in this way (email comm.:2013). "Reconciliation sounds a bit like the terms used in the grief of war or recovery from similar aggression" another respondent says as she admits she has not heard of RE. Like others she "prefer[s] restorative" (pers. comm.). However, Ecological Restoration (ER) as "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed" is not an apt description either (Society for Ecological Restoration:2013). Another respondent disagrees. It is "[r]eplication not restoration" (pers. comm.). What

[16]Watson's curve shows that diversity rises with area, but is a relationship of diminishing return (Rosenzweig:2003). In other words, diversity on a small area of land is not doubled by doubling the land area. This occurs everywhere within a chosen region on earth and no matter what species is examined. Three SPAR curves are observed and interact: within a continent, between continents and from islands.

is replicated and to what degree this is possible is what is at stake for respondents.

When the environment may have been original is a source of contestation. Some suggest after the last ice age (Brown:1999), others before the Neolithic period (Webb:1985). Respondents are very clear that greenroofs are intended to replicate grassland ecology, which comprises over half the UK landmass. Grasslands are classified by The Joint Nature Conservation Committee Handbook (JNCC:2007) into: acidic; neutral; basic/calcareous; improved/reseeded and marshy and still further, into upland and lowland. The composition of the grassland depends on the quality and composition of the soil in a particular area. Soilscapes, as a form of dynamic and agentive material culture are often taken for granted and ignored (Salisbury:2012). Here, soil achieves primary importance.

The Moos Water Treatment roof (chapter nine) is one of the very few which one ecologist respondent claims does mimic grassland. However, it is not a deliberate preservation or restoration, it is 'accidental' mimesis of the local landscape by chance and over time. In London the roof of the Centre for Understanding the Environment (CUE) building at the Horniman Museum Extension deliberately mimics grassland. However, not all grassland species transfer unproblematically to rooftops, as a study by Sutton et al. (2012) concluded.

Ecosystems Services

Respondents interpret greenroofs as green infrastructure (GI) for ecosystems services (ESS). Natural England defines GI as "a network of high quality green and blue spaces and other environmental features" including: "parks, open spaces, playing fields, woodlands, wetlands, grasslands, river and canal corridors allotments and private gardens" (2013). They are "the processes by which the environment produces resources utilised by humans such as clean air, water, food and materials" (WEA:2005). Sea walls are grey infrastructure, but oyster reefs, which provide the same services are green infrastructure (Tercek:2013). McMahon and Benedict (2006) suggest that GI originated in the US in the mid 1990s, linking landscape with communities. Greenroofs, green walls and more lately, rain gardens[17] offer ESS as an additional solution to excess water management in urban areas.

The Bruntland Report creates the world as an integrated global biosphere, whole but

[17]These are features on the ground which collect and store storm water, allowing free draining to trees or plants.

"fragile" (WCED 1987:pl). It positions sustainable development as a unifying strategy: linking biospheres and economics, people and nations into a holistic, redemptive system. It also attempts to instil the desire for equal justice between the economic, ecological and social tripartite of environmentalisms and balance exploitation and dependence. Post-Fordist relationships with nature focus on the protection of species and biodiversity and the rise of commercialism, where genetic material is mined as "the oil of the 21st century" (World Resources Institute quoted in Brand 2009:107). The definition of biodiversity reflects such logics. Biodiversity (biological diversity) is defined as:

> the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (CBD:2014).

Re-interpreted logics of the market make seedbanks and genes subject to bioprospecting and commercialization, "justifying the appropriation of nature" in the context of climate change and the disappearance of biodiversity (Brand 2009:107).

Many commentators contend that the environmental movement has become irrelevant, unsuccessful (Latour:2004) or worse; impotent (Meppem and Bourke:1999) over the past 50 years. However, not only does environmentalism now stand at the heart of government (Darier:1999; Luke:1999), but organisations which were previously marginalized, such as Greenpeace and Friends of the Earth, are now central to policy and research (Eder:1996; interview:2010).[18] Environmentalism was easily adopted into already existing systems once it became re-framed in terms of Foucault's (2002) concerns of contemporary governmentality: population and economic management (Bryant:2001; Castree:2008b; 2010a; 2010b), risk (Castree:2008a; Girardet:1992) and security (Beckett:2006). This is because governments and environmentalists share these same concerns (Luke:1999). Darier (1999) claims that this process changes the way governance operates, but Latour (2004) laments that these alignments (Luke:1999; Rose and Miller:2010) did not redraw the political/natural landscape as they promised to do.

ESS were legitimised by the United Nations through a global study carried out by more than 1,400 scientists (Norgaard:2010) between 2001 and 2005. They assessed the world's ecosystems, framing them in terms of benefits, or services (Percu and

[18] Elected Member for Sustainability, LBZ. December 2010.

Lubchenco:2005). Linking the biophysical and socio-economic through a framework of provision, regulation, support and culture, ESS provides an alternative to the tripartite structure of the economic/environmental/cultural model of sustainability introduced by the Bruntland Report (WCED:1987). Castree describes this kind of thinking as the 'neoliberalisation of nature' (2010a; 2010b). Nature's services are directed towards human benefit within a risk/analysis calculative framing which focuses on scarcity and ecosystem health by quantifying degradation and loss.[19] This is positioned in terms of risking a policy of doing nothing. The consequences for the environment, built and otherwise if no action is taken, is the onset of a future dominated by dwindling natural resources and climate change (GLA 2008:2). This has become one basic assumption within the London Plan.

The ESS framework is applied at different levels, from international to local. In 2011 the Department for Environment, Food and Rural Affairs (DEFRA) published the UK's national assessment. The author, Bob Watson concluded that the UK's green spaces are worth at least £30bn a year in health and welfare benefits, with inland wetlands worth £1.5bn a year and bees at least £430m a year to agriculture. Watson argues that the assessment should be used to shape government policy at the national and local level.

> Putting a value on these natural services enables them to be incorporated into policy in the same way that other factors are. We can't persist in thinking of these things as free (Watson quoted in Harvey:2011).

ESS makes the environment 'sensible' (Ranciére:2004) to economic and political decision-makers. However, as McAfee laments, green developmentalism opens nature to the logics of the open market and:

> fosters the fantasy that we can 'green the planet' while continuing to grow along demonstrably unsustainable economic trajectories. It offers a rationale for the illusion that biological diversity can be 'saved' without fundamental changes in present distributions of political power (McAfee 1999:151).

Alf Hornborg goes further to argue that money and debt are relationships between people, not between people and nature. "Ecosystems" he says, "are not offering their

[19] There are underlying notions of Systems Thinking and balanced or steady-state ecosystems in this philosophy. It relies heavily on ideas of 'resilience' to shocks again positioned as being external to an ecological system.

'services' on the market, nor do they have any use for monetary compensation. Money is a claim on other people" (Hornborg 1996:57). This rise of the neoliberalised nature has gone hand-in-hand with the emerging field of neo-Marxist political ecology (Bryant:2001; Biersack and Greenberg:2007).

Linking ecosystems with business and markets in a new way, allows the opportunity for previously non-pecuniary notions such as well-being or spiritual enrichment (ibid) can be monetarily valued. Although this is new way of thinking about the environment and nature and is seen by many as an opportunity for a realignment towards social inclusiveness, others question how much this is actually being achieved (Woodcraft:2012).

A further critique of ESS is the variety or 'bundled services', which are offered (Kosoy and Corbera:2010). However this is one of the keys to greenroof success (chapter four). Critics (ibid; Norgaard:2010) also argue that the homogenization of natural systems in order to establish a standard unit ignores the variation which local ecosystems display. What standardisation and ESS have accomplished (McCaulay:2006; Vatn:2000) is the elision of the ethical dilemmas of economic logic where ESS as " 'blunt instruments' ignore fairness and equitable distribution" (Cobera et al. 2007:608). By contrast, Berg and Timmermans describe standardization as "an effect of distributed rather than centralised actors and activities" (1997:275). As I argue throughout, the standardization process has been beneficial for the proliferation of the greenroof as a material form.

The affordance of greenroofs to be standardised has allowed them to cross international boundaries, in plant form, as designs or as policy, digital photographs and legal documents. Local variation in form and ecology is what respondents recognise as agentive. However, as chapter nine discusses, standardisation through policy has resulted in the apparent equivalence of a piece of ground to a piece of roof and the consequences of this certainly appear to "ignore fairness" (ibid).

While McAfee (1999) laments the selling of nature to save it, as do my respondents, the links between environmentalism and liberalism and more latterly neoliberalism, have been seen by some as the journey of nature from separation, domination and exploitation (Stoll:1997) to a recognition, via climate change, of rapprochement and co-dependancy (Milton:1993) through the logics of management. Although, a return to privatisation as the predominant economic model suggests that this is not so much neo/new as advanced liberalism (Osborne and Rose:1999).

Nature, within the management logics of advanced liberalism is defined in terms of

biodiversity and ESS. It is measured and managed and held to account which means that GI has to pay its way. It cannot be implemented because it is 'the right thing to do' regardless of the cost benefit analysis. Ultimately, this marks a difference between my respondents who exhibit an idealistic or utopian vision and others with whom they work who are variously described as "bean counters" and "the enemy" (pers. comms.). The former are greenroofers (my term) with an idealogical commitment to the natural world, the latter are not. Greenroofs as a material form link communities of greenroofers in managerial processes with others who are often not environmentalists. ESS are a way of meeting on common ground, not perfect, but good enough.

A very British Nature

The term 'nature' is so multivariate that whatever 'agental cut' (Barad 2007:158) is desired can be accomplished. What exactly constitutes nature, and where it is located is historically and culturally constructed (Strathern and MacCormack:1980). Greenroofs come out of a network of respondents who share an understanding of what nature is and what it can do. These respondents share a fairly narrow range of politically left-leaning British discourses on environmentalism, although they vary as to the 'deepness' of their ecological responses. While the environment movement was active before the 1960s (Pepper:1984), for a post-war generation, Rachel Carson reshaped the conceptual landscape in the 1960s. She redefines nature in terms of the loss of a species when asking people to imagine a *Silent Spring* (1962). This is an interconnected nature where a threat to one becomes a threat to all.

The interconnection metaphor has been highly influential throughout the ecological movement and beyond (Nerlich:2003). Some (Sachs:1999) also credit the photographs of the earth taken from space in 1969 as conceptualising an earth which is home, unique and holistic. Interconnectedness is also central to permaculture philosophy, particularly the idea of globalism, tied to Erlich's (1968) Neo-Malthusian emphasis on overpopulation and the uncontrollable material expectations of emerging economies. Nature is abundant and self-balancing and contrasts with people who are isolated and cities which are out of control. An intrinsic, instinctual love of nature; 'biophilia' (Wilson:1990) enables people to adapt and evolve biologically and socially (Kellert:1997).

James Lovelock's (1979) holism cemented a generation's belief in climate change. The anthropomorphic Gaia is gendered female, in the role of mother: fecund, nurturing

and self-balancing but now endangered and requiring rescue, resonating with Marx' "labour is the father of material wealth, the earth is its mother" (Capital I 1995:134). Many respondents find discourses where women and indigenous people are closer to nature productive of a model of inspirational behaviour for and a source of new moral and ecological ways of living. This involves a direct, knowing and personal (phenomenological) relationship with nature, despite the now widespread critiques (Brosius:2006; Hviding:1996; Ingold 1996; Rayner:1989).

The approaches of sociobiologist E.O. Wilson (1990) and the structuralist, post-marxist, social ecology of Murray Bookchin (1982) have also been influential within environmentalist networks. This personal connection with the natural world where psychological and emotional connections are forged is explored in Arnie Naess' (1990; 2008) work. This is a Romantic combination of the Spinozist notion of becoming and Taoist principles of living in harmony (Fox:1995), described as a: "universal right which cannot be quantified. No single species of living being has more of this particular right to live and unfold than any other species"(Naess 1990:166).

These theorists shift the natural world to a more equal status with the human world and this is still deeply threatening and problematic today. Although the environment has, for some considerable time, been heavily regulated with Acts of Parliament such as *The Clean Air Act* of 1956, since the 1960s environmentalists have argued that the environment has been neglected in law and that while corporations enjoy legal status as individuals, so too must the environment. A legal status to protect 'the natural world' was marked by Stone's 1972 attempt to give trees legal status and, over time, has resulted in a biotechnological framework protecting biodiversity, and species (Kopnina 2013:11). Mabey's (1973; 2008; 2010; 2011) writing on the importance of urban ecology is particularly salient to respondents and in many ways enables greenroofing to succeed in London (chapters three and four). Running through all of these inspirations is the trace of a Marxist urban analysis where city-dwelling humans exist separately from nature. This has been productive of ecological discourses of alienation and UK environmentalists have repeatedly pressed this claim through a footprint replacement theory (chapter five).

My respondents reject such ideas as Gibson's (1986) declaration that nothing exists outside of nature, even synthetic materials. For example, they claim the built environment is 'unnatural' because it is humanly constructed, but the moral character of 'naturally sourced' materials; usually mud, straw, clay, thatch, which come from 'the earth' with minimal processing, mitigate the effect of the un-naturalness of building. Respondents recognise McKibben's (2006) and Žižek's (2011) declarations that (an un-

spoilt) nature does not exist,[20] or that there are multiple natures. They hold varying degrees of 'deepness' as to how 'natural' they believe the bio-technological may be, dependant as it is on culture to exist (Berglund:2006). They may not be familiar with techno-natures; assemblages (Guattari and Deleuze:2004) or hybrids (Escobar:1999; Latour:1993); 'naturecultures' and 'interspecies knots' (Haraway 2008:15, 35), or 'natures in tension' (Escobar 1999:6), never-the-less, they continue to assert nature's existence, which they can identify and of which plants are a part, physically separate and independent but culturally entangled.

Respondents often use nature and the environment interchangeably as in Milton's definition of nature: "the complex of natural phenomena with which we share the universe and on which we depend" (Milton 1993:2). Sharing and dependance, or more accurately interdependence, characterise this network's broad relationship with Nature. Respondents use the notion of working with Nature, not against it. Greening London with plants is the methodology and the goal of Ecotopia.

Ecotopia: History, Process and Localism

Utopias are alternative visions of societal redemption whether political, economic, social, religious, technological, anti-technological or ecological producing retrotopias, technotopias, ecotopias etc. (Unwin 2006:334). It is through Hundertwasser's (1958; 1983; 1990) work and philosophy, that the elements of the greenroof network come together in London (Gedge:2010). Hundertwasser describes the ecotopian (ecological utopia) building as greenroofed and alive with phyto-materiality, the plants, building and residents in harmony, providing an antidote to alienation and urbanization (Rand:2007; Restany:1998). Utopia is 'u-topos,' (no place) or 'eu-topos' (the good place). It is provided through spacing (Kraftl:2009): a condition for the condition of utopia. The greenroof provides a complex set of affordances for living and living well, not just for flora and fauna but for humanity. It provides benefits for problem-solving within the governance of London which is argued to be deliverable at personal, societal and global levels. Because buildings are processes (Kingwell:2006; Yaneva:2009), or "building events" (Jacobs 2006:11) there is no single narrative or vision of utopianism between human actors or between human and non-human.

The idea of taking space in the contemporary city to produce utopian spacings for wildlife is a bold one. Never-the-less, from Plato's Republic through More's 1516

[20] Žižek (2011) sees this ecological crisis and the calls for new ways of living, consuming and communality as part of the death throws of neoliberalism.

vision and into the ecotopias of the present day, the built environment has been identified as a site of correction for many of society's problems or injustices. The recent recognition of the city as the quotidian environment for more than half the world's population (SCBD:2012) revitalises the notion of the built environment as an appropriate site of governance and remedy.

Governance and Research

There is a long history of governing through problematizing issues (Rose and Miller:2010) such as urban space and the built environment in the UK Research, policy and legislation have acted upon the built environment, directing its shape, form and content. Architecture, in turn organises the disorder of the city (Campkin:2013). Two major issues arose during the 19th century and became linked during the shifting demographics of industrialisation (Smith:2003). The Germ Theory of Disease of the 1860s focused legal attention on health, hygiene and sanitation and resulted in legislation such as the Public Health Act of 1875.[21] Housing surveys (Booth:1889; Rowntree:1901) drew a statistically explicit causal link between social conditions such as the overcrowding in London[22] and the subsequent social responses. Overcrowding became linked with poor sanitation, ill-health and poverty, in a process Hacking calls 'making people up' (1986) and this catalysed a succession of social and housing movements.

The response from the wealthy and social mobile upper classes was to flee from pollution and disease[23] by building country homes.[24] These led to large scale building projects for middle class suburbs[25] and later, railway suburbs for the working classes.[26] Laws[27] encouraging slum clearance and cheap rail travel enabled building materials and construction workers to travel out of London's centre, and residents to commute in (Cherry:1979; 1996) configuring the patterns of the contemporary city.

[21] New housing required running water and drainage. It also included pavements and street lighting.

[22] Using census data, Dewsnup (1907) calculated overcrowding at 16% but well over 30% in many northern cities and in Finsbury, Shoreditch and Stepney. These figures were produced after overcrowding had lessened (Cherry:1996).

[23] Cholera, smallpox, tuberculous and typhoid.

[24] Constructed along the country estate model, minus the extensive land holdings.

[25] Suburbs like Willesden and Hornsey in London and Kings Norton near Birmingham (Cherry 1979).

[26] East Ham and Walthamstow (Imrie et al.:2008).

[27] The *Cheap Trains Act of 1861*. *The Housing of the Working Classes Act of 1890* dealt with identifying and isolating unfit houses, and either improving or rebuilding them.

Intentional Communities and Industrialisation

The response to "cultural anxieties about the meaning of work, the measure of fulfilment, and the extent of communal obligations in an industrialized society" was met by a "frenzy" of utopia-building in the US and Britain around the 1820-50s (Brundage 1996:3, 6). Religious communities of Quakers, Shakers and Amish sought separation or isolation. Others, inspired by Marx and Fourier, as well as Victorian literary utopias, included Owenites, Perfectionists, The Harmony Society, the Fourierist Phalanxes and Brook Farm in Massachusettes (ibid). All "were governed by explicit ideological tenets that had a pervasive influence on how they manipulated the material world" although as recent archaeological evidence demonstrates, the material betrays the level of success in achievement of these ideals (Van Bueren and Tarlow 2006:3). Others disintegrated quickly, but most, while not reproducing society exactly to their ideals (Claeys and Sargent:1999; Jacoby:2000), achieved what Graeber calls "medium-term goals" (2007:1) and redistributed the sensible in Rancièrian (2004) terms. Some communities like the Amish are no longer considered experimental.

Metcalf's description of the 'mega-trends' in intentional communities suggests that in Victorian times, they were large-scale communities of middle-aged and older people, who moved from the industrialised city to the country. These communities were carefully planned "with most aspects of personal and social life closely prescribed" (2013:92). During the 20th century, intentional communities became smaller, younger, "quasi-anarchistic" and by the late 20th century community size had increased, as had age, planning and constraint (ibid). Anti-industrialist themes trace through 20th century utopian intentional communities to Findhorn, founded in 1962, on the West coast of Scotland. The community, based on new-age spiritual principles (Sutcliffe and Bowman:2000), inspired the ecovillage movement (Litfin:2009) by promoting an abundant, self-balancing relationship with Nature.[28] Findhorn has been highly influential in spreading a whole systems approach (ibid), herbalism as a complimentary medical form and inspiring the Centre for Alternative Technology in Wales, where one of my respondents taught until 2013.

The model villages built by philanthropic industrialists such as Titus Salt (1803-1876), Joseph Rowntree (1836-1925) and Arthur Guinness (1725–1803) were inspired by a mix of new social research and enlightened self-interest. Villages were built complete with company owned shops, pubs, libraries and workers given better working conditions. They find their contemporary equivalent in people like Bill Dunster who

[28]The village enjoys a coastal position along the Gulf Stream.

shows how carbon neutral housing can contribute to policy at the national level by building demonstration projects like Bedzed (Lovell:2009). The architecture in villages like Poundbury, built by Prince Charles, echos the past Victorian village model and Ebenezer Howard's garden city model which holds at its heart a redemptive faith in nature (Harris et al.:2008; Smedley:2010), but is unreflexively aimed at housing the middle classes (Macleod and Ward:2002).

Critics construct their own counter narratives which dismiss, ridicule or trivialise intentional communities (Hayden:1976; Hewitt et al.:2007; Perl et al.:2005).[29] Poundbury, established in the mid-1990s, has frequently been described as mediocre or lacking vision (Tavernor 2007:6) and Prince Charles as a "perpetual architect-botherer" (Smedley:2010). The Arts and Crafts Movement is characterized today largely in terms of style, but it was a radical social experiment, examining class, women's suffrage, socialism, working conditions and the philosophy of production, with no less than the morality of society at stake (Cumming and Kaplan:1991). As an educationalist, theorist, writer and lecturer, William Morris (1894-1896) promoted his "hatred of modern civilization" and inspired Ebenezer Howard's Garden City Movement which was also a romanticized improvement model designed to transform society through suburban housing (ibid:15). Pepper (1984) points to a similar distrust of modern technology within the 20th century ecology movement. The romantic village model is re-emerging (Smedley:2010) fuelling contemporary notions of greenroofing and localism (chapter nine). The 2014 Wolfson Economics Prize is offered for a new and contemporary garden city (O'Sullivan:2013).

At the same time, the City Beautiful movement,[30] and the Parks Movement (Jordan:1994)[31] were concerned with improving physical and moral health and supported by the 1875 *Public Health Act*. This made money available from central government through local authorities. Health and hygiene continued to be a concern of governance, reconfiguring architectural space and reorganising light, colour and the type, location and form of rooms by focusing on the newest materials and technologies. Early Socialism employed all these notions in the design of communal spaces such as kitchens, dining rooms, libraries, gymnasiums, child-minding and laundry facilities.[32] Socialism, like modernism and the Garden City Movement was

[29] Local newspapers ridicule sandal-wearing residents during the opening of the Hampstead suburb (and Orwell, in *The Road to Wigan Pier* (1937) also links sandal-wearing residents of Letchworth with nudists and feminists and failed socialism (Miller 1989:92).

[30] Linking civic architecture with the moral goodness and right of the Nation and Empire.

[31] Cronon (1995) links the US (National) Parks Movement with a romantically informed reaction to industrialism.

[32] Reminiscent of the material feminist designs (Hayden:1981).

a different response to many of the same problems (Buchli:1999a; 2008).

Housing continued to be a pressing issue after the World Wars. The British people developed an expectation that the new welfare state would rebuild the nation. The Housing for Heros building boom fulfilled this social contract by providing homes and continuing the slum clearances. *The Housing Act of 1919* required councils to provide housing and was strengthened by *The Housing Act 1930.* These were followed up by *The Town and Country Planning Act 1947* which for the first time required planning permission for new-builds. The rise of British inter- and post-war town planning was overseen by architect Raymond Unwin (1863-1940). He was strongly influenced by the work of William Morris (1834-1896) and art critic and philanthropist John Ruskin (1819-1900). Along with Richard Parker (1867-1947) he built several of Howard's model villages and garden cities. The garden city concept became international: the USSR, Germany and Scandinavia, all developed similar plans, based on Letchworth. Under lawyer Ralph Neville's business plan, these houses became a way to "pacify and improve conditions of workers" (Jacoby 2005:37). The garden city of Leningrad was later held as an example of a corrupt state with the rise of Le Corbusier (1887-1965) and the Urbanists who, in contrast to Howard and Morris, believed industrialism was the key to social reconstruction.

Tempting as it is to think of these housing plans as simply architectural they are, as the post-war County of London Plan (Forshaw and Abercrombie:1943), known widely as 'The Abercrombie Plan' makes clear, also spacial. Open spaces, long distance walks, gardens, interconnected park system and lakes are incorporated as vital to the vision of housing:

> the town dweller to get from doorstep to open country through an easy flow of open space from garden to park, from park to parkway, from parkway to green wedge and from green wedge to Green Belt … A great advantage of the linking parkway is that it extends the radius of influence of the larger open spaces and brings the latter into more intimate relationship with the surrounding areas (ibid:39).

Architects working for local authorities led the post-war building project and by 1979 council (social) housing accounted for approximately one third of Britain's housing. Many of London's major estates constructed during this time were modernist projects such as The Barbican, Golden Lane Estate and the estate which houses Mill Lane Community Centre (chapters five and nine). Town planners, however, did not anticipate

the baby boom, longer life expectancy and the trend towards smaller and single person households which led to housing shortages by the 1970s (Holmes:2005). Many now believe Le Corbusier's skyscrapers, geometric grid systems and stark modernism have proved dystopian, particularly in the context of failures in the 1970's British mass social housing construction. However, many of these modernist projects are still vibrant and dynamic places to live, giving evidence to Sir Terry Farrell's (paternalistic, but accurate) explicit link between buildings and money:

> "We have mismanaged high buildings for residential by putting the poorer people in them without the resources to run and manage them. It takes more money to live in a high-rise" (Thompson:2013).

In the mid to late 19th century, health hygiene and sanitation were problematised (Campkin:2013) and linked to housing, within the context of a wealthy nation, built on empire. After the middle of the 20th century, the rise of the welfare state, the Cold War and the rise of consumerism were the chief defining characteristics. Current and contemporary concerns involve the changing climate, but the same constellation of private, public and commercial buildings mix with social reformers, scientific research, policy and law-making only the configurations shift. The welfare state and public sector are shrinking/reforming in response to increasing neoliberal governmental policies (chapter three). These political and economic circumstances inform and shape the introduction and form of greenroofs.

The Future is in Process

Lyman Tower Sargent's concise description of utopia as 'social dreaming' (1994), is escapist and compensatory, carnivalesque and subversive,[33] critical and estranging, dystopian or transformative. As Foucault (2001) and McKenna (2002) discuss, these kinds of end-state utopias can lead to a sterility of achievement and a denial of reality. Jacoby (2005) (see also Van Bueren and Tarlow:2006) suggests that utopias are in decline after the fall of Communism and the totalitarian regimes. Jameson (1991) attributes the decline to a general postmodern depression after the decline of teleological history and grand defining narratives such as 'progress'. However, many still regard a utopian vision as necessary for an emancipatory and environmental politics (de Geus:1999; Eckersley:1992; Garforth and Kraftl:2009; Pepper:1984).

[33] Interpreting the oppositional play of the Situationists as utopian (see Gardiner:2006).

The fixed 'steady state' of the fixed ideal is typified by environmentalist Ernest Callenbach's *Ecotopia* (1975). This is a fictional area of Northern America seceded from the US. In many ways, it mirrors the travelog style of many utopian novels, such as Bellamy's Looking Backward and may be read as a reaction to the 1960s. The nature described is steady-state, self-contained and self-balancing. While some (de Geus:1999; Eckersley:1992) regard *Ecotopia* as influential,[34] the kind of steady-state ecology and pre-scripted societal regulation described do not reflect contemporary utopias or ecotopias.

The shifting emphasis on process (Levitas:1990, 2000; McKenna:2002) addresses the understanding of persons as relational, social and expressing difference: "knowledge is influenced by one's situatedness" (McKenna 2002:4). End-state visions become "inspirational but adaptable" focusing on "the process of transformation itself" (Levitas 1990:172, 9). Operative goals should be evaluated reflexively: "[w]e must create both the conditions of our responsibility and participation and a method for fulfilling them" (Mckenna 2002:9). How the "possible futures-in-process" and "ends-in-view" of a core vision interact is a tension that forms the background to this thesis.

The Future is Personal

The postmodern utopia (and dystopia) is "downsized and personalised" and concerned with the aspirations of the individual (Moichi 2006:222). This downsizing is literal, following Schumacher (1973), influenced by Kohr (1957), where ecotopianism sees beauty in smallness, harkening back to the village model as a response to contemporary concerns over the loss of culture and communication (despite evidence to the contrary) in contemporary society. The contemporary utopia is a heterotopia: a utopia of otherness (Hetherington 1997:7) which encourages individual ideal places, investing them with meanings that vary in spatial and social position. Heterotopia constitutes the utopia of liberal individualism (Nozick:1977). It disrupts the taken-for-granted, is process orientated, without universal application and with imperfections which mirror and account for the material world as it exists.

The 1990s marked a shift to localisation in British politics under the Labour Government, influenced in part by the Bruntland Report's emphasis on indigenous peoples, environment and participatory politics (Roy Ellen pers. comm.). The 1990s also marked a shift from the governance *of* Nature to governing *through* Nature.

[34] It was self-published but sold over 300,000 copies in eight languages (Garforth:2002).

Priorities moved away from the provision of a wide social security net to strategies of self-reliance, now central to the Conservative/Liberal Democrat policies in times of austerity. Visions of an ecological 'green' London revolve around discourses of localism where individuals and grass-roots organisations take responsibility for a locality (GLA:2008; 2011). Agarwal (1998) notes that since the Bruntland Report (WCED:1987), governments recognise that resource management should involve local people. Rydin (2007) suggests one way in which this can be accomplished is through participatory policy making. Building partnerships between people as citizens and local groups, businesses and communities, where local governments becomes more accessible allowing people to participate in and influence future policy. Environmentalists see affordances within these trends. Luke's (1999) notion of alignment is well noted and adds to what Anderson calls a 'politics of pragmatism' (2012).

The personalisation of political and global dissatisfactions over issues such as genetically modified crops (Pepper:1984) food insecurity (GLA:2010) slow food (Castells:2001; Pink:2009) and the oil crisis (Hopkins:2008) have resulted in local, grass-roots movements and networks which turn on global similarities but significant local differences. Decreasing biodiversity, the bee crisis and flooding have directly given rise to a plethora of contemporary ecotopian aspirations to green the city: guerrilla gardening, the Capital Growth Scheme, Transition Towns Network (Dickson:2009), edible bus stops in Lambeth and edible towns such as Hebden Bridge. How greenroofs become shaped by these alignments is evident through strategies, plant and materials choice, the associated DIY culture and an emphasis on an ends-in-view ecotopia.

Kassman's definition of ecotopia as "the desirable ecological alternative" (1997) separates out the desired state as an alternative to mainstream society. Separation from society, however, is not the ecotopian way, despite Callenbach's vision. These contemporary personalisms and localisms are situated in the everyday lives and places of ecotopians. Carbon accounting personalises climate change by giving everyone and everything a footprint (Giradet:1992). Buildings become identified as the problem and simultaneously, the site of correction (Dickson and Buchli:2011). The 25 million separately owned dwellings in the UK contribute 27% of the country's carbon emissions (HCSC:2005). By grounding planetary scales, literally domesticating them and making them visible at the personal level, the built environment offers affordances for problem solving (Carsten and Hugh-Jones:1995) at multiple scales. Dobson argues: "an ecological politics is a quotidian politics" (Dobson 2009:134). It breaches and

rewrites the public/private divide in new ways as feminism and cosmopolitanism did before it. The duty of the new environmental citizen is to live sustainably in private and public. Ecotopia converges on and becomes part of the everyday (Kraftl 2006; 2009; 2010).

Miller (2005) argues that objects shape behaviours and thinking precisely because they become naturalised; common sense and invisible. It is exactly this unremarked 'new normal' which greenroofers seek, so that it becomes natural and normal to want to grow plants on a roof. Although they would not use the word ecotopia, their vision is one where plants have the best possible conditions in order to thrive and produce vibrant, diverse, complex and mature ecosystems. Greenroofers recognise affordances in the urban built environment as they appear to flora and fauna. They then attempt to provide the best conditions for biodiversity on greenroofs. This is no less than a reorganisation of the way in which plants, animals, birds and buildings interact, supporting each other. It is the creation of nature. In turn, greenroofs provide ecosystems services leading to the correction of problems gathered together under the rubric of climate change. These become the key to human health and happiness. What is at stake is human continuance and a resilient, responsive, comfortable built environment under the conditions of a changing climate.

This network of respondents under discussion are notable for their pragmatic approach. They reject a problem oriented focus in favour of a future of solutions. Respondents often have to make compromises in order to successfully manage the transition to a 'green' ecological city. The stated goal of my respondents in the greenroof network is reform the governance of London in order to produce new areas for biodiversity. In doing so they balance the tensions between unending possibilities versus the structure and prescription of materially constructed natures. They target policy in order to ensure greenroofs become mandatory. They believe this is the best route to success legally encoding their vision of ecotopia making it more likely to materialise. To do this, the greenroof network is conducting and encouraging research, influencing policy and legislation, building demonstration projects and encouraging the commercial, public and private markets to adopt the practice. This is a solutions-oriented, managed future.

Conclusion

At the heart of both affordance theory and utopia is the notion of intentionality. Taking out intentionality strips utopia of hope (Garforth and Kraftl:2009; Sargisson:2009).

So central to utopianism has intention been that, while unintended consequences challenge the concept, questions about intention shake it to the core (Garforth and Kraftl:2009). Intention is bound up with agency, and as with other dimensions of the human mind, it should be understood as a distributed, emergent and interactive phenomenon rather than as a subjective mental state (Garforth:2009).

Evident within the greenroof network is a strong intention to green the city, encapsulated by the photograph on the cover of the *Living Roofs and Walls Technical Report: Supporting London Plan Policy* (2008).[35] This is an end-in-sight, flexible, constantly reassessed and in-process strategy. Strategies are "immutable mobility," not fixed sequences of action (Suchman 2006:19). London may be the template but the intention is to disrupt the grey-roofed sky vista and through policy and practice develop greenroofs as normal, everyday, domesticated, unremarked-upon. The ESS underpinned by an independently agentive nature in the form of webs of biodiversity achieve these ends whether humans are present or not.

This is not a future *beyond* intention, multiple and engaged in 'difference without ends' as the Deleuzian theorists might have it (Lorimer:2008), ending in what Zygmunt Bauman calls a "multitude of opportunities" (2000:61), but which Levitas worries might end in "pathological pluralism" (2000:40). The answer, McKenna suggests, is a process of:

> seeking conditions that promote further development rather than seeking an ultimate or perfect way of being … embodies the concept of process as the only possible 'end,' pushing us to realise that it is our goals that inform and direct the process and that, ideally, as long as we keep forming pictures of the future there is no 'end' (2002:97).

The complex materiality of London will not enable the end-state vision of living under a forest, nor is every existing building capable of being retrofitted for a greenroof. The materiality of the built environment pushes back. The intention is clear, as is the methodology, but the ends-in-view continue to remain open, contested and, in theory, intentionally democratic. The ends-in-view *will* allow a series of greenroofs, green walls, roof terraces, gardens and food-growing spaces. Material form here is flexible, diverse and offers affordances for multiple interpretations. This is an open-endedness of form, rather than vision, perhaps. Neither is the vision predicated upon all members of society participating in the ecotopia because greenroofs will act upon

[35]Online here: http://www.london.gov.uk/sites/default/files/living-roofs.pdf Licensed through Getty Images for a substantial fee.

the material conditions of London's environment on people's behalf and as several chapters indicate, an ecological London is not everyone's idea of utopia.

4

Greenroofs Afford Greenroofers

> The place acts dialectically so as to create the people who are of that place (Tilley1994:26).

> Brownfield species are opportunistic and I am quite an opportunistic person. You create opportunity and nature fills it, especially in an urban situation where things are always changing (Gedge quoted in Lorimer 2008:2051).

This chapter has two aims. Firstly, it introduces a network of people involved with greenroofs and the ideas they have about themselves, aspects of nature and greenroofing practice. With broad brushstrokes, I call these ideologically committed people greenroofers. For these purposes only, greenroofers fit broadly into two groups. The greenroof network is a loose association of people involved in a community of practice. They are activists, ecologists, policy-makers, botanists, biologists and roofers, but come together to work for and promote greenroofing in London and elsewhere. The second community of practice is the LBZ sustainability team who project manage greenroofs at the local authority level on social housing. These groups of people are not separate. Members of the sustainability team were ecologists and activists working inside LBZ. They knew and had formed working partnerships and collaborations with the greenroof network outside LBZ on many occasions, such as the Mill Lane project (chapters five and nine).

Secondly, the chapter discusses how knowledge about greenroofs became authoritative, actionable and successful. Using Foucault's notion of an episteme (1980:187) to describe what, of all the things it is *possible* to say, becomes *acceptable* to say, Lipschutz and Kütting describe the 'climate episteme' as consisting of a:

> 'hard' kernel of science-based knowledge but surrounded by a 'cloud' of inferences, claims, assumptions and arguments … what the broader public 'knows' about climate change (2009:206).

The greenroof network are both informed by this episteme and simultaneously add to it by generating research, encouraging policy, leading educational workshops, training, seminars and widening the debate on climate change towards the introduction of GI and ESS. In other words, they attempt to redistribute the sensible of that episteme (Rancière:2004).

The construction of the episteme is also the mutual constitution of greenroofs and greenroofers. As Renato Rosaldo says, "[e]thnographers can learn much about meaningful action by listening to storytellers as they depict their own lives" (1986:98). She suggests that these "spontaneously told myths" can reveal what is culturally relevant for the story to work in a given situation (ibid:98). The founding myths[1] of the contemporary London greenroof network is a tale of heros, charismatic birds and the historical countryside recreated and geographically removed from harm to produce a wildness. The story situates the protagonists, assembles and stabilizes contingency and through constant repetition excludes all possibility that things could ever have been any other way.

Mr Green Roof and The Gallant Few

In the late 1990s, a few activists, ecologists and keen environmentalists started drawing connections between and developing particular kinds of ecological knowledges about climate change and urban species of wildlife. They started building and developing greenroofs, joining others and developing a wide network of industry, public sector, commercial, non-profit, researchers, professionals and do-it-yourself (DIY) enthusiasts in London, Germany, Switzerland and globally.

[1]The problem of using the term 'myth' is that it can also imply untruth/fiction/fantasy. This is not what I am suggesting here.

Dusty Gedge claims the bragging rights of "being there at the start" (interview:2011). He is a charismatic activist and self taught environmentalist. Dusty is a showman. He starts interviews with me and others with his coming of age as a circus performer, actor and street entertainer during the 1980s when he also modelled as a punk. He has appeared on television and in a recent film about environmental degradation in the Amazon Basin. His nickname "Mr Green Roof" is something he enjoys very much.

Dusty tells me that his interest in wildlife started at an early age by recounting how he fell out of his high chair, chasing a robin. The story, which is often repeated in other interviews (LSDC:2011) establishes and communicates an ecological identity. This is a trope which features heavily in the ecological literature. (See Monbiot:2013; Naess:1990, 2008; Wilson:1990; Pollan:2002). Dusty is a knowledgable ecologist (but self-taught as several other respondents keenly point out), photographer and activist interested in urban wildlife. He 'occupied' brownfield (ex-industrial) sites undergoing regeneration in order to prevent building until Black redstarts (*Phoenicuros ochruros*) had finished nesting. His identification of the protected bird (Lee:2009) drew him into contact with both developers and other ecologists as they were forced to undertake ecological surveys when he made the birds visible. This kind of relationship was important: "my advantage was not to be constrained by the mission statement of one organisation. I didn't approach it being an architect or in the construction industry – I learned on the hoof"(ibid).

Dusty is a raconteur and gives enthusiastic and energetic presentations and tours. He is also an East-ender, from Deptford in south-east London and he is still immensely proud of staying local. During the 1990s, he was part of a group he calls 'the gallant few' who started out at the Deptford Creek Ecological Centre (Gedge:2003b; pers. comm.). The Creekside Regeneration Programme commissioned the Ecology Centre to undertake a survey of the creek's wildlife and about this time, greenroofs found Dusty. He maintains (interview:2011) that he cannot remember who came up with the idea of rubble roofs and in many ways it does not matter. They became key to arguing that regeneration does not have to be destructive for wildlife habitat. Dusty's first greenroof was built on the nearby Laban Dance Centre, a building designed by Herzog and de Meuron and completed in 2003. This was Dusty's first brown (rubble) roof. Several high-profile roofs followed, establishing him firmly for many as Mr Green Roof. Dusty sees this expanded personality as a tool for producing greenroofs: "and fortunately, for me, I became someone who became recognisable as someone very, ah, very, knowledgeable" but he is also modest: "I'm only the spokesperson" (interview:2011).

This initial network of 'the gallant few' moved throughout London over the years and have become influential in the governance of the city. Jill Goddard, who was the Ecological Regeneration Manager, ran the Creekside Environmental Programme at the time of the assessment. She went on to become Ecological Regeneration Manager at LB Lewisham and is currently Executive Director of the Thames Estuary Partnership. Nick Bertrand, an ecologist, was Caretaker Manager of the Creekside Education Trust until 2009, and Chris Gittner still hands out wellington boots to eager creek-side explorers at the centre. Mathew Frith (Gedge and Firth:2004), an urban ecologist, is mentioned occasionally as one of the few. He was Landscape Regeneration Manager at Peabody Trust, urban advisor for English Nature and is now Deputy CEO of the London Wildlife Trust. The network has expanded and includes many influential actors throughout London.[2]

Dusty is an example of an activist who is able to make a living through his activism. He is now a director of the Green Roof Consultancy, with Gary Grant (below), a director of Livingroofs.org and President of the European Federation of Green Roof Associations. He has worked on approximately 300 greenroofs and one of the high-profile successes he claims is the Barclays Bank building in Canary Wharf.

> Getting Barclays to put a green roof on top of their tower in Canary Wharf was a highlight for me. It's the highest green roof designed for nature conservation in the world at 160 meters tall (Lee:2009).

When asked if he had ever been accused of 'selling out', he recalls a few comments after the financial crash in 2008, but nothing serious. He suggests: "when one considers that the City of London is full of flat roofs owned or leased by big business then engaging with the enemy is not a compromise but a must" (pers. comm.).

Dusty's close network includes three other greenroof activists and old friends. They too combine their professionalism and activism and together they run greenroof sem-

[2]James Farrell (Biodiversity team at the GLA and one of the founders of Brighton and Hove Building Green) contributed to the GLA *Technical Report*, Rachel Hill (National Flood and Coastal Risk Manager at the Environment Agency), John Newton (managing director at Ecology Consultancy Ltd. and environment director of Crane Environmental Ltd.) worked on the CIRIA guide with Dusty, and Jamie Dean (Senior Design Manager at Design for London, GLA). Pete Massini (works for the GLA), Jenny Scholfield (now with the Environment Agency), Adam Ingleby (works for the Environment Agency and runs greenroof courses in Brighton), Trudi Thompson (a social entrepreneur, founded Bricks and Bread Sustainable Living Centre). At other times, the network includes commercial partners and academics Dr Alun Rhys Tarr (Director, Blackdown Horticultural Consultants) and Peter Allnutt (also Blackdown), Dr Stephan Brenneisen, greenroof researcher and lecturer in Switzerland and Dr Gyongyyer Kadas, a researcher and lecturer at UEL. Later associates include: landscape architects; local authority officers, GLA officers and business partners and they represent some of the influence in ecological circles in London and elsewhere not just in breadth, but over the last 30-35 years.

inars, training and building courses, collaborate on a variety of projects UK wide and promote greenroofs throughout the world. One such friend and alliance is Gary Grant CEnv, MIEEM, a consultant ecologist, who recently conducted the biodiversity assessment of the Olympic Park (OP BAP:2009). He is an enthusiastic green wall and infrastructure expert and designer. He is a Member of the All Party Parliamentary Group on Biodiversity, and Academician of the Academy of Urbanism. His perspective is on of ecological holism:

> Cities themselves are ecosystems and adopting an ecosystem services approach will bring essential improvements to the way that we plan and manage our cities for the future (interview:2011).

Now specialising in ecological assessments, ecological design, master-planning and green infrastructure for ecosystems services, Gary designs and builds green walls and roofs, for example, the green walls at the Westfield shopping centre, the Greenwich underground station and the Palace Hotel in London. He has authored several books and papers (Grant 2006; Grant:2012a; Grant:2012b) and has also worked with Buglife, an invertebrate charity, on their *Best Practice Guide for Creating Green Roofs for Invertebrates* (Gedge et al.:2011).

Gary started work with the London Wildlife Trust in the 1980s and became involved with greenroofs when he was managing nature reserves for the London Wildlife Trust (LWT). They obtained a steel shipping container. "I instructed the volunteers to put turf on it to hide it. That was my first, that was instinctive almost. How do we hide this? We painted it green and covered it with turf" (interview:2011). One of Gary's early commissioned roofs was for the Centre for Understanding the Environment building at the Horniman Museum Extension, constructed in 1993. (Appendix I, photograph 6). This is a successful biodiverse roof of which he is extremely proud. Gary describes a lull in greenroofing from the late 1980s. In the mid 2000s he was commissioned by English Nature to write their research report on greenroofs. He attributes his successful bid to being the only applicant who had actually built a greenroof. Around this time, he started collaborating with Dusty and others.

John Little built his own greenroofed house near London 17 years ago and has run the Grass Roof Company since 1998. He has installed about 70 small, domestic and school greenroofs and runs frequent greenroof training courses. He also co-authors with Dusty (Gedge and Little:2013) and works with social housing tenants to develop local gardens. The school roofs in particular have been enormously influential, increasing

the visibility of greenroofs.[3] John says that the value of greenroofs is that they: "are close to people. Small scale … and a catalyst for change, green roofs give people a push – in the right direction" (interview:2011).

John handles and enjoys the complete process from design through sourcing materials and building. He indicates that it all hinges on design: "get the design right and put in effort at the start and it makes a big difference between something adequate and something special" (ibid). He has developed an interest in making 'bee hotels'. These provide nesting affordances for solitary bees and can be fixed to any kind of infrastructure (photograph 4). He also demonstrates an extensive commitment to using recycled materials like reclaimed wood, crushed brick, old tyres for planters, recycled plastic, cans and glass.

In 2011, John and Nigel Dunnett won a silver medal at the Chelsea Flower Show with a design for a greenroofed home office set in a water sensitive garden. The home office was a repurposed sea container. Nigel Dunnett is director of The Green Roof Centre at the University of Sheffield and professor of planting design and vegetation technology at the university and along with James Hitchmough, Sarah Price and LDA Design/Hargreaves Associates, designed the planting for the Olympic Park, Stratford. He does not collaborate on training courses in London but coordinates an extensive research programme in Sheffield and works closely with the city council.

In many ways, Blanche Cameron unites and coordinates the group through her work as founding director of RESET-development. RESET-development is a non-profit organisation set up in 2007[4] offering training in ecological adaptation for the built environment. RESET-development provides advocacy and facilitation to support communities and conduct research into low-energy, low-carbon concepts. It is through RESET-development that Blanche coordinates training courses with Dusty, John and Gary as trainers.[5] Blanche has a diploma in Architecture from Glasgow School of Art. Her career trajectory from senior lecturer at the Graduate School of the Environment at the Centre for Alternative Technology (CAT) to the University of East London and now, to the Bartlett School, UCL illustrates how 'alternative' building techniques are becoming incorporated into the mainstream. She is also a member of the All-Party Parliamentary Committee on Biodiversity and designs ecological projects including

[3]The difference between the start of 2011 when I met very few people who had heard of greenroofs and the summer of 2012, when I manned a stall for The Urban Wild Project and discovered that a large number of people were now familiar with them because their children's schools had greenroofs.

[4]By the start of 2014, it can no longer attract sufficient funding and has shut down.

[5]The list of people they network with for training and seminars is ever changing, and the concentration is on the core group of people met during fieldwork.

community self-build. She is founder of the Ecosystems Services comes to Town Conference with its annual design competition, which is now gaining international recognition. Her approach is holistic; connecting the connections: "Everything is connected … we wanted to take a much more holistic approach to adaptation … sharing information … it's about action, for adaption, for nature and for us" (interview:2011).

Blanche, through RESET-development have strategically identified and connected with a large and growing network of professionals who are influential in shaping the built environment, in London and elsewhere. She explains:

> Councils have a more strategic approach. Planning, policy-makers. It's where the regulators at that level, at that strategic level. Then it's the built environment professionals, so we're looking at the people who make design decisions. You've got the building commissioning sector, so insurers, developers … and then you've got academia and academia is interesting because you've got people who have time to explore certain things. But, that's from the student end. But, from the teacher's end, you've got people who don't understand these processes teaching architectural design, in an era when we need to be adapting our buildings …chartered professions are one of our target audiences (ibid).

RESET-development run training courses and attract a wide audience: communities, DIY-ers, local council officers and a wide range of professionals. Training was initially general but, over the years, has developed for different audiences. By 2012, there are DIY to professional master planning courses and a water management for council officers. The Green infrastructure masterclass is now accredited. Blanche describes the importance of achieving acceptance of an ESS approach into the Royal Institute of British Architect's (RIBA) core curriculum. As one professional governing body this was particularly important because it shapes architect's future practice. "It will be a way of institutes setting their work within a climate adaptation framework and accepting that this is our major challenge for the built environment" (ibid).

Brodie McAllister, a landscape designer I met several times at events and training courses also believes this approach is essential. Brodie worked as a consultant on the Brooklyn Bridge Park in New York, Barking Town Square and Islington Green, in London. He specialises in master planning and believes that GI needs to be incorporated from the very start of a project, not placed at the end, "like set dressing" (pers. comm.). This a radically different way of designing which features interdis-

ciplinary working to achieve sustainable design. It features long term thinking, site remediation by plant growth, integrated transport and green corridors.

The 'Caped Crusader'

Another key actor in this network is the Black redstart (*Phoenicuros ochruros*). The use of 'charismatic mega fauna' or 'flagship species' to highlight environmental campaigns has been general practice since the 1980s (Leader-Williams and Dublin:2000). Mega fauna are usually top level predators which can be anthropomorphised and to which humans respond to as charismatic, cute, or culturally significant, like tigers, pandas and penguins. Images of endangered polar bears balancing precariously on melting ice sheets have become emblematic of climate change.

The bird has drawn diverse networks together. Dusty's and the redstart's histories are intwined. As an activist, Dusty 'occupied' the bird's nesting sites in order to protect nesting pairs. "I closed down maybe ten sites in about five years because the Black redstart is protected. And of course my life in green roofs is closely allied to these little fellows" (interview:2011). The redstart became a charismatic species (Gedge 2003a:2) for the London Biodiversity Partnership (LBP) who audited the Deptford Creek area. The bird became associated with all London brownfield sites and all founding green-roof narratives, seminars, lectures and training courses repeat the importance of the Caped Crusader.

The Black redstart is an Alpine bird of the thrush family. It was until recently, at the top of its European breeding grounds in the south of the UK but has been spotted in Denmark (Bird Guides:2014). The male is black and dark grey, with white wing streaks and the female is browner in colour (photograph 3). Gilbert describes the redstart as a mountain and cliff songbird and rival to the robin (1989:115). Redstarts inhabit brownfield sites in the UK because they resemble the rocky cliffs of its native Alpine habitat (Kollinsky and Landman:1996) with high, complex, relatively undisturbed structures, near water, with sparse but herbaceous vegetation for insects, seeds and flies (Blackredstart.org.uk:2013; Lee:2009).

Multiple pairs of redstarts took advantage of the increased rubble after WWII in London and Birmingham (Gedge:2003a) and they were first spotted breeding at the Wembley Exhibition Centre in 1926 (Blackredstart.org.uk:2013). A survey carried out in 1977 (Morgan and Glue:1981) recorded 33 breeding pairs in London and 71 pairs outside the capital. The regeneration of The Barbican area forced approximately 16 pairs

of redstarts to move to the increasingly abandoned London docks during the 1980s. By the time Gedge et al. describe the redstart as of "significant ecological value" it was also identified as threatened with only three pairs found in the Creekside area survey, constituting more than 1% of the national population at that time (Firth and Gedge:2000).

The Caped Crusader became a powerful material consideration within regeneration schemes and involved in policy formation through its status as a protected bird. Redstarts are a Red Data bird[6] in Britain (RSPB:2009), listed in Appendix II of the *Bern Convention on the Conservation of Migratory Species of Wild Animals*, and it is a protected species in the UK, with schedule 1 status under the *Wildlife and Countryside Act 1981*. This makes it unlawful to kill, injure or disturb and damage their nests and eggs. Dusty claims that policy makers and the construction industry exhibited indifference towards the birds in the 1980s. It is just as likely that developers knew little about redstarts, ignored policies where there was no enforcement or penalty and/or that the potential of brownfields as economically lucrative overrode all other concerns.

Dusty talks about the difficulty of making greenroofs relevant to city and local professionals during the 1990s and early 2000s. What changed this, he suggests, were the links he and others made with Dr. Stephan Brenneisen of Basel University in Switzerland. Brenneisen had been building greenroofs to provide habitat for redstarts and invertebrates and developing the well established Swiss policy and regulatory process. He shared this strategy with Dusty in London and Dusty in turn is sharing it with others. Recently, in Portland, Oregon, the Streaked horned lark (*Eremophila alpestris strigata*) was identified as their own local charismatic but threatened bird. Discovery of the rare lark on brownfield sites by the river halted redevelopment until rooftops could be identified for its relocation (Benjamin et al.:2013).

Dusty and Gary both regard the redstart as nationally important, even though it is only found in a few British cities. They engaged in a double manoeuvre with local planners and policy-makers. Having argued that there was very little wildlife in London and that this was characterised by the endangered redstart, they then argued that there was a large amount of wildlife, particularly on brownfield sites. These are abandoned, often ex-industrial sites, produced by the "uneven geography of capitalism" (Mah 2012:8). They became identified as unique ecological niches especially for rare invertebrates (Mabey:1973). Since regeneration was considered inevitable greenroofs could replace the disappearing brownfield land which had become the chosen habi-

[6]The RSPB use a traffic light system where 'red list' birds are globally threatened, with severe, at least 50% population decline over 25 years.

tat of the redstart. Dusty demonstrated this by installing the first biodiverse rubble greenroof on the Laban Dance Centre in the Creekside area in 2002 (Gedge:2011a).

While greenroofs started as a conservation strategy (Evans:2005; Lorimer:2008), they soon moved on.

> …and we got a few greenroofs - it was fantastic. But you soon realise there are only 20 pairs of black redstarts in London, so if you use redstarts as the only argument, you only end up with 20 greenroofs (Deshi interview:2011).

The provision of greenroof ESS expanded urban greening making it relevant to a wider audience of professionals, especially surrounding the issue of water management in London. As Deshi relates, this was difficult: "[t]he flooding argument, most people wouldn't understand that argument. Even planners don't understand that argument" (interview:2011).

Many of the affordances offered by the greenroof are not visible, or well understood, so a world-wide research industry has grown up to investigate the hydrology and other associated benefits. Universities have opened dedicated research centres in Germany, Australia, Greece and Brazil. Some internationally known centres include: The Green Roof Centre at the University of Sheffield and The Sustainability Research Institute at the University of East London, the Center for Green Roof Research at Penn State in Philadelphia and at the University of Toronto. The most recent to open is the Kadas Green Roof Ecology Research Centre at the University of Haifa in Israel. They all organise research through test-beds (photograph 14) where the scientific research attempts to control and regulate the conditions under investigation as much as is possible during outdoor biological experiments.

The Green Roof Centre at Sheffield University test-beds are employed chiefly for monitoring the performance of substrates. The centre is funded by and orientated towards research for their German partners ZinCo who manufacturer greenroofing products such as substrates and insulation liners. Funding frames the direction of research. The London researchers partner with organisations and charities who fund the construction of greenroofs. They tend to monitor and investigate a greater number of roofs *in situ* for biodiversity, energy savings and sustainable urban drainage (SUDs) benefits, although UEL have recently opened their first test-bed roof. Research centres engage with external partners to encourage policy, construction standards, implementation and monitoring and work in close alliance with ecologists, builders and

designers. These interactions are framed in terms of policy recommendations and barriers to greenroof uptake (GLA:2008; Lawlor:2006; Newton et al.:2007; Ngan:2004).

Research became linked to the rise of evidence based policy making within New Labour's Third Way Philosophy in the 1990s. Solesbury refers to this as a "utilitarian turn," where in times of reduced funding, research is targeted to benefit society in pragmatic ways (Solesbury 2001:2). At the GLA, Deshi like all my respondents, is convinced that the most effective way to achieve urban greening is to "collectively push policy at different levels" (interview:2011). Previous attempts to introduce of greenroofs in the 1970s at the Greater London Council[7] failed because at the time greenroofs were 'only' an ecological matter. Biodiversity, and specifically the loss of brownfield biodiversity, despite being encoded in a large number of documents at all levels of governance is not enough. As Luke suggests: "'the e-factor' is not merely ecology – it is also efficiency, excellence, education, empowerment, enforcement and economics" (Luke 1999:133 italics in original). Rozenzweig understands this when he frames RE as 'win-win ecology' (2003).

Greenroofs fit perfectly into the EES turn because they demonstrate multiple benefits for managing the urban environment. Greenroofers proposed that London's roofs could be greened in order to solve multiple problems of water, energy and environmental management and this was legitimized by GLA policy through *The Technical Report* (Dusty interview:2011; GLA:2008, 2010). Policy introduced during Ken Livingston's time as Mayor now requires that all large new buildings in the City of London have to include some form of greenroof at a ratio of a minimum 28% for amenity and the rest, up to 70% for biodiversity or successfully defend their decision not to.[8] This is being encouraged throughout the boroughs through *The London Plan* with differing levels of success (see Appendix II).

Greenroofs, from their beginnings as a campaign issue to one of conservation, through policy and planning, are now implicated in city-wide issues like flooding and more recently air quality until finally being accepted through aligning with architectural and development agendas in terms of providing new green spaces. "At the end of the day it's about greening the urban environment, about greening whole surfaces, whether its a greenroof, or a platform. Its about making green space" (Deshi interview:2011).

This EES turn has not been accepted uncritically by respondents. While greenroofers still position biodiversity and ecology at the heart of their personal project, at the

[7] Dismantled in 1986.

[8] By September 2013 a new city-wide greenroof policy is being drafted (pers. comm.).

same time, they recognise that they have to promote greenroofs in terms of EES to businesses and policy-makers. Money, as Simmel (1903 [2002]) suggests, transforms objects into commodities. Greenroofs have become a commodity. My respondents recognise this but identify a problem with placing a monetary value on ecosytems. "It seems crazy" says one: "that it takes putting a monetary value on the obvious to make certain people sit up and pay attention! - but if that's what it takes…" The second respondent replies:

> something inside me seizes up when I hear the natural world described and commodified as assets. I suppose it is necessary in order to communicate its importance to all the bean counters out there but it makes me squirm

and the third sums up:

> Look beyond the financial as that is where we've been going wrong. Ecosystem services have unfortunately become synonymous in some people's minds with money value, whereas they are really just the natural processes we all rely on" (pers. comms.).

There is a quality of nature which respondents believe is inalienable and should stand outside economic valuation. They claim an expert level of guardianship and even as they run training courses, they guard this closely. Being a nature 'buff' and demonstrating a knowledge of plants enables access and connection to this community of practice. People can develop that knowledge and connectedness develops over time, however, the experience of building a greenroof secures an instant connection.

Milton (2002), along with many others (Carrier:2003; Garner:2001; Pepper:1984) discuss how personal feelings, emotions and biography have to be sublimated before being subsumed into more technical and rational management practices in order to be accepted. For example, the emotional and bodily engagement Dusty has had with the cities, especially Portland, has made a deep impression and he retains this. He says: "in the winter, it bloody rains. We think it rains. It *fucking* rains. I've been there when it rains. And *fuck* does it rain. It fuckin' fuckin' rains" and we laugh (interview:2011). He wins policy makers, planners and developers over with this kind of enthusiasm and energy (but not the unguarded language). However, he is more measured when giving talks and training courses, while still conveying enthusiasm, humor and emotional engagement. Blanche states it more simply: "and its about when you're not afraid to be able to say the word, you know, 'Nature' " (interview:2011).

Dusty stands as one node in the centre of a large network of people concerned with ecology, green infrastructure, policy and governance in London. He has an extensive international network and travels frequently all over the world as a speaker, researcher, policy advisor and broadcaster. He, John Little and Blanche Cameron are (in 2013) engaged on a British city tour of greenroof training and information courses. In material terms, training, seminars, competitions, award ceremonies, meetings and networking events were frequent additions to all my respondent's calendars allowing them to interact and exchange ideas. "It is precisely by rescaling processes that networks have the power to bypass or subvert conventional hierarchies of power" (Leitner 2004:246 quoted in Sayer 2006:104). Dusty the maverick, is the perfect example of this. Beholden to no one, he moves enthusiastically, connecting and reordering many networks in London and beyond.

Working in the GLA are three more contacts who I met regularly during fieldwork. One was an ex-LBZ sustainability officer and two others were members of the Urban Greening team. Dean has a degree in physical geography, and a speciality in hydrology. Deshi has known Gary Grant since they both managed nature reserves for the LWT and he worked with Dusty at English Nature recording Black redstarts. Deshi describes how important these networks are:

> It's about knowing those people and constantly being in touch with them… Gary and I, initially involved in an NGO doing a lot of campaigning and lobbying style, I worked for the LEU[9] which gave advice direct to the boroughs and actually influenced the local authority level through policy. Gary ended up being a consultant so he's used to working with developers… I think its about having people in different parts… you gradually end up joining up all the dots (interview:2011).

GI is a pragmatic approach based on what Lipschutz and Kütting describe as "the schism between environmental necessity and institutional feasibility" (2009:207). These flexible networks and communities of practice (Wenger:1999) reflect the way that Barker (1997) characterises conservation and ecological thinking about nature as corridors, communities, networks and mosaics. These ideas reflect movement, connection and reconnection between seemingly separate spheres.

Policy and organisation literature tends to separate environmentalists and policymakers, insisting that the former put pressure on the latter, whom they view as deeply

[9]London Ecology Unit.

recalcitrant. Councils tend to be characterized as 'further down' the policy-making process, only capable of responding to city, national or external policies, or bodies. Lovell (2009), for example, using a model of policy entrepreneurship describes how these entrepreneurs are external to policy circles and how they exert influence *on* policy-makers.[10] This overdetermines inside/outside oppositions, levels and scales and, as I discovered there is much less of a boundary between inside and outside these organisations or between policy-makers and environmentalists. The second section of this chapter now concentrates on the members of the sustainability team at a borough council who collaborated with Dusty, Gary, John and Blanche at various times and in different roles, through training and through building projects.

LBZ

My second group of respondents all work within a London borough authority which is undergoing substantial change.[11] Over the last 30 years the public sector has been 'rolled back' (Kelsey:1993) and continues to be shaped by substantial cuts in local government provision (Raco et al.:2006; Richardson:2010; Rose:2005). This has facilitated increased market involvement resulting in outsourcing of many local government functions (Peck and Tickell:2002). Prime Minister David Cameron's (2010a) vision of the Big Society includes deep reductions in public services coupled with a more sharply pronounced rise in personal responsibility, growth of the third (voluntary) sector and private enterprise (Alcock:2010; Kisby:2010).[12] Local authorities now contract out many of their services[13] which, arguably, reduces costs and increases choice, competition and quality (Langton:2012). The resultant 'quasi-private sector' (Rutherford 2007:295) is still huge, despite the reductions in Government funding.

Statuary obligations placed upon local authorities have not reduced in line with reductions in funding. This is reshaping public services, shifting them from the role of provider to enabler (Harrison and Davis:2001). The quasi-market creates 'active cit-

[10]Lovell is not asserting that there is no other method of policy-making, only that she is concentrating on the role of individuals in this instance. However, this neglects the role of teams, social networks and political economy which throughout this thesis I argue are just as important.

[11]Parts of this section appear in Dickson (2013).

[12]The Conservative government of 1979-1997 and the current Conservative/Liberal Democrat coalition believe that the market should restructure and co-partner in the public sector. The approach of the Labour Government (1997-2010) is described as a pragmatic, stakeholder driven response to lack of funds (Falconer and McLaughlin:2000). The emphasis for them was on service provision, even if this shifted to co-partnership.

[13]LB Barnet have outsourced ***all*** **their back office work claiming potential savings of £125 million (Langton:2012) and have presented this as: "What's best for Barnet" (barnet.gov.uk).**

izenship' (Kisby:2010) by enabling: helping people to help themselves. While some (Charities Chief Bubb in Telegraph:2013; Dunt:2013) have declared the Big Society dead, the cuts continue to shrink and re-organise the public sector. David Cameron emphasised that this would involve "more for less" (Cameron:2010b) and he positioned the cuts as a reduction in "middle management waste" (CIPFA:2011).Overall, Government funding to councils is to decrease by approximately 26% from the financial years 2011/12 to 2014/15. As 70% of LBZ's budget comes from central government, they calculated a deficit of about £100 million over the years 2011-14. Senior managers intend to meet this by reducing staff numbers by 1/3. This is significantly more than the one in seven (700,000 people country-wide) predicted by the Chartered Institute of Personnel and Development (CIPD) (Philpott:2012).

Warren Hatter laments that local councils have failed to embrace the *2000 Local Government Act* which gives them free reign to do anything they wish, as long as it is legal. He also suggests the sustainability (LA21) agenda became "sidelined, or subsumed by other issues with stronger statutory and financial drivers" (2009:8). The ongoing funding reductions severely restrict projects and push dedicated officers to become highly inventive funding managers. The local council's hybridity as a public organisation means that it is regulated in order to manage funding and limit profit. Ongoing funding reductions mean that officers adhere to statutory obligations, rather than developing creatively. At the same time, management seek to introduce new management practices which produce the kind of flexibility they argue the corporate world demands (pers. comms.).

The Energy and Sustainability Team

Administration of LBZ is divided into three directorates: Housing and Adult Social Care (HASC); the Schools and Families directorate and the Culture and Environment directorate. Each is separated into divisions, sections and subsections, each operates from separate offices, and each has a separate sustainability team. The Schools and Families team consists of one full time and one part time officer who encourage and support teaching about climate change. The Culture and Environment directorate team expand from nine full time positions to 20 by March 2011, at a time when other departments are shrinking. They are organised into: community engagement, technical projects, air quality, carbon management and energy management. The energy and sustainability team with which I conducted my fieldwork operate within the Housing and Adult Social Care (HASC) directorate. The housing repairs and im-

provement division is divided into sections and subsections, and the officers who worked in the sustainability team are part of the commissioning and quality assurance section, positioned in the sustainability strategy sub-section. They are known informally as 'the sustainability team', with HASC added only when it could be confused with any other directorate's team. It consists of 11 officers in 2009, but by the time I start in 2011, it has been reduced to four full time positions. One of these is a job-share, so there are five officers.

Tom formed the team. He has a masters degree in engineering and another in design and he came from a nearby local authority in 2003. He has developed and managed many projects such as the retrofitted eco-houses, carbon counting and greenroof projects and the others describe him as "the ideas man" of the team (pers. comms.). He developed the team as *intrapreneurs*, i.e.: corporate entrepreneurs (Pinchot and Pinchot:1978). These are defined as:

> "employee initiative from below in the organization to undertake something new; an innovation which is created by subordinates without being asked, expected, or perhaps even given permission by higher management to do so" (Vesper:1984:295). (see also Antoncic and Hisrich:2003).

Tom has many of the qualities ascribed to intrapreneurial team leaders. He is a blend of creative and practical (Macrae:1982), researches extensively and thinks 'outside the box' (de Jong and Wennekers:2008). Frank, acting senior sustainability officer is Tom's protege and feels he has "learned everything I know from him" (pers. comm.). He has an ecology degree and a special interest in biodiversity and greenroofs. Since joining LBZ in 2006, he has also accumulated expertise on solar photo voltaic (PV) technology, internal and external insulation, and he is an expert networker, with extraordinary funding application success. Dusty and Tom's networks overlap and they are both very well connected within London and elsewhere. They also work on LBZ projects together (chapters five and nine).

Sandra and Merav job-share. Sandra works on fuel poverty grant programs, educational outreach and vegetable growing projects. Merav undertakes carbon assessment, manages the HASC databases and has project-managed a second, award winning demonstration eco-home. He is present during my pilot fieldwork but goes on secondment to complete a masters degree in sustainability. He drops in for lunch occasionally and we correspond by email when he returns.[14] Tamsin is an engineer

[14]In July 2010, the other team members include the borough-wide insulation manager and his clerk

who has lived in England for nearly a decade. She works on a large, well publicised combined heat and power (CHP) project. This requires technical skills the team do not possess, so they hire Tamsin as a consultant project manager. They refer to her occasionally and affectionately as 'agency' to reflect her external contractual position. Although she will leave when her contract ends, she is thought of and treated as a full member of the team. Tom and Frank are dedicated to sustainability as is Merav and Kofi (before he left). The others are motivated differently. For example, Tamsin is not particularly concerned about sustainability, but she enjoys her job for the technical challenge.

Under Tom, the family-like (pers. comm.) intrapreneurial team (Macrae:1982) unites round sustainability. They are "the dreamers who figure out how to turn an idea into a profitable reality" (Pinchot and Pinchot 1985:12). This is more than a job; it is a mission. Like others in the team, Tom often attends evening or weekend events and does not claim time off in lieu. While people have disciplinary specialities and are assigned their individual projects to manage, in reality everyone but Tamsin works on multiple projects and there is a continued practice of information sharing, brainstorming and teamwork with the feeling that everyone is supportive and that the team is working very successfully. They are all extremely proud of the multiple awards their projects have won over the years; locally, city-wide and nationally and their trophies sit, gleaming, on the windowsill.

In the absence of a preexisting sustainability strategy, the team design their own research and development remit. This is pragmatically accomplished, centered round need, restraints, funding streams and innovative solutions. Personal values on environmental issues stimulated by research into sustainable technologies allow the team to test solutions against what the organisation allows and enables. For example, Tom and Frank's personal desire is to increase biodiversity across the borough, but this was never a priority for the housing directorate, so they aligned their interest in greenroofs with policy on energy efficiency and water management. Hitting multiple targets legitimized their projects.

The team often hold conflicting beliefs about what LBZ as an organisation 'thinks' about sustainability. LBZ has verbal and written statements of sustainability and they see their roles as both expert and vital in relation to these commitments. LBZ, in many ways, is open to sustainability as a working strategy as long as it produces

of works who also take on additional sustainability projects. They are both made redundant by the end of 2010. Kofi emigrates in the late summer of 2010. He is not replaced. The intern leaves soon afterwards.

benefits to residents and organisational efficiencies. Funding is always a constraint and the team never have an adequate budget. Their projects are always funded externally and they occasionally interpret this as a fundamental lack of commitment to sustainability from LBZ. Many of their colleagues are convinced that sustainability is meaningless, see it as an imposition on their personal expertise, as an inconvenience or are climate deniers. The group often feel separate from and at times think of themselves as working against many of their colleagues. "It was a battle sometimes, the wheels were not greasy with green grease" (Frank email comm:2013).

The team proceed regardless of the "resources they currently control" (Stevenson and Jarillo 1990:23). Tom takes both initiative and risk, often on behalf of the team. As de Jong and Wennekers (2008) note, intrapreneurial risks are lessened through working within an organisation because of the restrictions placed on workers and the security afforded them. Pushed to seek external funding, Frank often says that he secures the money first and plans the projects later. After I left LBZ, Frank told me that he argued with Davina. She had asked for full details of how he was going to spend a grant he was only just applying for. He was angry and irritated that she did not understand what a waste of time this is. The important point was to secure the money first, then work out the project details.

Vital to the intrapreneurial working style is an interest in researching new technologies (ibid). Tom and Frank foster this in other new team members over the years, garnering expertise and knowledge about the application of greenroofs in different forms and locations. It is also their belief that by accessing enough external funding and gathering enough research to back up their claims they can make these projects work. Finding the funding to sustain the housing stock and housing teams is a huge budgetary drain on LBZ.[15] The sustainability team however, identify social housing as a hugely valuable asset to tackle climate change and one which they exert some measure of control over. Tom and Frank both describe working at LBZ as the instrumental level where they "can do the most good for the most people" (pers. comms.).

Tom targets their projects skilfully, and they build professional relationships pragmatically. They prioritize and focus on carbon reduction targets, energy and money

[15]Tony Blair's Labour Government *(1997-2010), sought to transfer management of social housing to Arms Length Management Organisations (ALMOs) through Large Scale Voluntary Transfers (LSVT). Creation of ALMOs was a condition for local authorities to receive the fuel poverty reduction grants they need to meet statutory targets of the Decent Home Standard.* There are 14 ALMOs in London *(National Federation of ALMOs:2013). 77% of LBZ tenants voted to reject ALMOs, calling it "blackmail" and said that private companies meant less accountability, control and representation. They called for direct investment in social housing (www.insidehousing.co.uk). This landmark decision is still talked about, years later, in hushed tones in the LBZ office because it means that while other councils have hit or exceeded their 2012 targets for fuel poverty, LBZ have failed to do so.*

savings and warmer homes for residents. Many projects are low cost and avoid the Tollgate process.[16] Funding is primarily sought from the private sector through Public Private Partnerships (PPPs).[17] These are vital because the team's internal funding proposals are always rejected. Funding applications produce official sanction and leave a paper trail which can be referenced for success by the organisation. Their work became largely invisible and produced a precarious position where they felt they had to keep "below the radar" as Tom (and others) repeatedly described it. They had learned a lesson from the first eco-house retrofit.[18] The project was accomplished by partnering with businesses who welcomed the opportunity to trial their products cheaply, in-situ on social housing. Tom met with an elected councillor who inquired about the cost. When she learned that to replicate this process without external funding the cost would be £500,000 the horrified exclamation was "*how much*?" Tom's explanation involving reduced spend due to economies of scale was of no comfort to the councillor who, by this time, would only ever remember the initial shocking figure.[19] It is simply not possible to envision such a substantial spend on every social housing property. Not only is there not enough money, but because it is not fair to spend a substantial amount on only a few properties. This was proof to Tom that he had chosen the right course of action, keeping the team "below the radar".

The consequences of keeping a low profile became clear when the first round of redundancies target the team directly. Early in 2011, there is a reduction of 290 jobs across all LBZ directorates, with HASC being hardest hit. This is the first stage of making 1/3 of the workforce redundant. The team's invisibility became evident through the new organisational chart produced to inform the housing directorate officers of organisational changes (Dickson:2013). The team found that they had unwittingly been identified as "middle management waste" (CIPFA:2011). Their team was no longer considered necessary. Tom constructed a document which he later successfully defended to senior management. This retention strategy argued that if sustainability is to be mainstreamed within the housing directorate, as senior management argue it is, this will require an expert set of knowledges and practices: *their* technical expertise. This is a temporary reprieve with the irony which has never escaped them, that the more successful a mainstreaming strategy is, the less the team will be required.

[16]Mandatory for all local authority procurement over £100K. Tollgate is a four stage process where projects are described, justified and tested in terms of: concepts; benefits; the organisation's core goals; plans; costs; minimization of risk and assessment of success. It can take a year to complete. I witnessed a 'fast' Tollgate process over six months.

[17]Osborne describes PPPs as the "cornerstone" of Labour's stakeholder society (2000:1).

[18]The retrofitting was one of the earliest in the UK. They won several awards for it in recognition of the advances and innovations it represents. Groups from all over the world visit regularity.

[19]The second eco-refit cost half this amount.

There are two compromises involved in saving the team. One is a reduction in officers to a total of five (two are a job-share). The second compromise is Tom's demotion. He is well loved and respected, so this is deeply shocking for all the officers. No one will ask him about it as is widely recognised "you never get a straight answer" (pers. comm.). In March 2011, Tom fails to secure even his demoted position which is yet another blow to the team. The newly appointed team leader is Davina who was co-joined with the team for six months prior to taking up the position, to support the financial workings. She is responsible for one other small team and does not manage projects. By her own admission, she knows nothing about sustainability and for this reason she is not accepted by the other members of the team because she is neither committed or knowledgable. Even by the end of 2012, Frank may grudgingly respect her project management ability, but is dismissive of her commitment to sustainability. "She likes formula 1. That is like a doctor who smokes or a nutritionist in McDonalds" (pers. comm.). The overall effect is a real emptying or 'hollowing out' (Jessop:2004) of experience, qualifications, technical and historical knowledge about already existing projects and the possibility for new ones.

Mainstreaming

As the team start to cope with fewer colleagues and more work, Davina holds a team meeting to announce that mainstreaming is now their strategy and goal. Mainstreaming takes a peripheral issue and makes it central to an organisation by "the embedding of attention … throughout the business as an integrated policy affecting the day-to-day decision-making and actions of the organisation at all levels" (Berger et al.:2007). For the officers, mainstreaming has saved their jobs for another 18-24 months but is now an ongoing work strategy. It becomes coupled with a re-orientation towards policy. Policy with its articulation in targets, recommendations, best practice and strategy now justifies and shapes projects. It was not that the team had previously been acting *against* policy, but the re-orientation means that all research and development projects now cease. There are no new or long term (over one year) projects and a cessation of those which focus on improving the existing local authority housing infrastructure. The team do not have the resources to calculate carbon, facilitate gardening projects and oversee research partnerships with local universities, although an already well established 'nudging' research programme with an out of town university continues. By July 2013, Frank secures funding for 11 eco-house retrofits, just before leaving LBZ. However, it is still unclear at the time of writing whether any

retrofits will materialise.

Only existing and target-driven projects continue. The CHP project, one of the new generation of such projects transferring heat and power from a large building to an estate and managed by Tamsin, is safe. It is already under construction, deeply embedded in policy statements, aligned with government policy on district heating systems, fully funded with the £3.5 million grant Frank secured and guaranteed to achieve multiple targets. Similarly, greenroofs survive austerity. They have been a part of the sustainability team's practice since Tom joined LBZ, when he authored the sustainability section in the LBZ *Sustainable Design and Construction Policy*, published in 2004. The updated (2010) policy states: "[t]his sustainable construction policy builds on our Corporate Environment Policy and aims to integrate sustainable development into all our construction activities." LBZ now has a policy of allowing greenroofs to contribute towards the zero net carbon effect required by the planning department when extensions are built onto private dwellings. This is a direct result of the team's discussion and advice to the planning department. By 2012, Tom is able to introduce greenroof targets into the LBZ Environmental Plan with a target of 20 greenroofs by 2015, or a rate of laying 700m^2 of greenroofs per year (HASC Review Report:2010).

The team is well on the way to achieving this target by 2012. They have laid 12 greenroofs, three in 2006, two in 2009, four in 2010, three more in 2011 and they have advised on numerous borough-wide schemes. One of these roofs has won a local award for innovation. As these projects can take up to or more than a year to complete and often depend on the cooperation of other teams, this is no small achievement. However, the team have spent this time advocating throughout the council which means, not only do many professionals in different teams know about greenroofs, but they are also knowledgable and experienced when it comes to installing them. By the start of 2011, one other housing team is laying a sedum greenroof, requiring only Frank's occasional advice.

Coming out of and being shaped by staff reductions, austerity and budget cuts, greenroofs have proved themselves extremely resilient as a building form. Their affordances as objects allow them to survive austerity. They are relatively inexpensive (£25-35,000 depending on size), externally funded through PPPs, and they improve already existing roofing surfaces. They can remain hidden or become visible as star features if required for publicity and award winning. They can be bundled with roof replacement projects which are already paid for and conserve scaffolding costs, which are very expensive. They draw multiple and diverse policy statements on biodiversity, water management, energy reduction and air quality together. The 'bottom

line' however, is that a greenroof will double the life of any flat roof. This extended life is a hugely persuasive benefit when local authorities are able to secure initial funding, externally for projects, but have dwindling internal and long term maintenance budgets. It means that mainstreaming the technique may not be difficult because there is a good deal of knowledge and experience with greenroofs within LBZ and because the sedum mat has achieved a level of standardisation (chapter four).

Conclusion

This chapter has introduced some of the people in the institutional and informal networks in London greenroofing practice. These people have influenced the governance of green infrastructure in London over the last few decades. While "Mr Green Roof" Dusty Gedge, is often regarded as the superstar of greenroofing in the UK, it is clear that there is an extensive and influential network. Activists work within organisations as well as independently. They have worked hard to placed themselves and their ecological concerns deep at the heart of London governance. Each person establishes authenticity by demonstrating a deeply personal, sensual and intimate knowledge about the materiality of nature, a point Anna Tsing (2005) makes about her respondents. This allows a professional persona to develop which is supplemented by the "intuitive understanding of nature" (Gedge 2003b:3). The chapter demonstrates how successful and influential this network of professional respondents have been, despite trade-offs and compromises. Lastly, the chapter lays out some of the economic and political conditions for greenroofing.

Arturo Escobar (1999) attends to the way that different regimes of knowledge production and experience operate on and with the same materiality. The greenroof as a material form affords different professionals with multiple concerns in the governance of nature and the built environment of London the opportunity to re-draw their disciplinary boundaries. Star and Griesemer (1989) would recognise the greenroof as a boundary object in this process, or as Olsen suggests "the thing is that which gathers, which brings together and which lasts: in other words, it relates qualities in time and space: the ideal node in a network" (2003:99).[20] Greenroofs align with the government's localism, sustainability and infrastructure agendas, as well as being flexible enough to be private, corporate, public and PPP funded. Greenroofers have shaped greenroofs through working within systems of governance just as intimately

[20]The etymological roots of 'thing' come from "the Old Norse/Old English þing and Old High German Thing: assembly, gathering, duration"(Olsen 2003:99).

as greenroofs have shaped the identities of greenroofers.

5

Phyto-materiality: Affordances for Ecotopia

> A building without a biodiverse green roof is wasting space (Shardlow quoted in Gedge et. al. 2011:foreword).

Introduction

This chapter examines how greenroofs offer affordances and are successful because of their materiality. I develop the notion of material layers in mutual combination with plant life as phyto-materiality. Combined, these layers achieve an 'effective configuration' (Blomberg et al.:1996) and the greenroof cannot exist successfully unless these constituents are correctly assembled. The materials offer capabilities and possibilities for agentive behaviors to flora and fauna. While the mass-produced or recycled material layers are important, it is the living, plant layer which is considered the vital component. It is these capabilities, which greenroofers recognise, rely on and reconstruct as material benefits for the governance of the built environment. Material processes assemble standardization but simultaneously the phyto-materiality resists this process, resulting in a highly variable form.

The chapter starts with a discussion of the anatomy of a greenroof. Gibson's the-

ory suggests that affordances are offered by the environment. However, as Suchman (2006) shows, affordances can be deliberately designed and built-in to an object. Greenroofs are affordance-rich habitats produced for nature. The second section examines the development of the brown roof as a material ecotopia, an affordance-rich environment for flora and fauna. Brown roofs are argued to be more productive of ecotopia than the green form. Deliberately designed affordances however can have surprising, hidden consequences. The last section examines affordances in terms of benefits designed to produce ecotopia for humans. Here I resist the temptation to 'nest' the affordances (Stoffregen:2010) as this is overly dependent upon drawing analysis out into levels. Despite the fact that Stoffregen suggests all levels of affordances are of equal value, nesting almost inevitably results in the privileging of ideas over material or physical benefits (protecting over sheltering, or human over insect affordances) as they become increasingly abstracted. Instead, plants, animals and humans require affordances as well as offering and providing them. They intertwine, interconnect, spiral, develop reciprocally in the production of ecotopias.

The Affordances of Roofs

Roofs are the coverings of buildings. The word roof comes from the "Old English *hrōf*, of Germanic origin; related to Old Norse *hróf* 'boat shed', Dutch *roef* 'deckhouse'. English alone has the general sense 'covering of a house'; other Germanic languages use forms related to thatch" (OED:2013d). British roofs protect against the weather, are built to exacting legal standards (covered by Building Regulations Part B and Part L) and conform to culturally constructed aesthetics. They are either flat or if more than a 10° incline, pitched (Harrison et. al.:2009). Flat roofs are found predominantly on commercial buildings and in cities and are the preferred sites for greenroofers. Flat roofs can potentially hold more weight and different substrates than pitched roofs (Johnston and Newton:2004). There are approximately 20 commonly used solid or liquid, hot or cold surfacing materials used in the UK including: asphalt; poly methyl methacrylate (PMMA) resin; bituminous membranes and concrete, slate or clay tiles (ibid). Most British roofs are pitched between 17.5° and 44°.

Greenroofs can be fitted over most roofing surfaces and up to a 30° incline. Over 15° some horizontal structural support, erosion blankets or slope stabilization nets (Werthmann:2007) are required to ensure the planting remains in place. There is a tendency to concentrate on flat roofs in the greenroof network as they are easy to access, build on and retrofit. They are also more susceptible to water ingress and

ponding (water pooling), so will last on average only 20 years in contrast to pitched roofs which are generally expected to last 60 years, or more. Longevity varies and depends greatly upon the type of materials used and conditions experienced such as: unintended loads; accidents; land settlement; ultraviolet (UV) light; wind; ozone and airborne or chemical contaminate action on materials. Water in all its forms is problematic with rain, humidity, and condensation being troublesome if not effectively controlled. Snow, frost and ice form and thaw in cycles affording expansion and contraction, which disrupts and deteriorates roofing materials over time.

Roofs are also dangerous and risky places where health and safety regulations are rigorously enforced, because any trip or fall could be deadly (HSE:2010). To work at heights a roof safety certification is required which depends upon successful completion of a physical day course and short but extensive written exam.[1] Although all workers are required to achieve this certification and observe full safety regulation when working on roofs, there is a lot of variation in practice. Council employees and their contractors are the most stringent adherents to the safety practices, clothing and regulations.

The first step in laying a greenroof is to assess the structure of the building and calculate the loading a roof can bear. This is preformed by a chartered structural engineer. He/she will assess the internal and external structure and identify features such as load-bearing walls. The constitution of the roof is assessed by visual examination, inside and outside. The structural capacity of the roof and walls is calculated and this almost always determines whether and what kind of greenroof, if any, can be laid. Surveyors will also identify strong and weaker roof areas and the shaping and loading of the final roof can be varied to accommodate this. Many older buildings tend to (but not always) be able to hold the extra weight of a greenroof. This spare capacity is what the contemporary construction industry calls being 'over designed' and more recent buildings are specified a minimum capacity which lacks any 'spare' capacity (The Green Roof Centre:2007). Retrofitting new but un-greened 1980-2010 roofs will be difficult in the future and require extra modifications such as structural reinforcement or floating roofs, anchored so that the weight is directed through load bearing walls. This will increase any cost dramatically.

Combining plants and buildings is also a risky physical process, albeit in a different way. It is managed via materials and processes through the use of regulations and standards. There are only a few plant species grown on or up buildings in the UK including ivy, wisteria, clematis, honeysuckle, rose and some small rooted trees

[1] I completed this course during fieldwork.

(RHS:2014). This is because of the damage plant roots cause to foundations and invasive suckers cause to walls. Woodworm, termites, bird droppings, squirrels, mice and rats, fungi, moulds and bacteria are also generally unwelcome on buildings (Douglas and Ransom:2013).

Roofs are classified and governed rigorously by processes of standards imposed on materials and building forms. This is accomplished through codes and practices, formulated by official bodies, written into law and designed to regulate the multiple building professions who have to work together on buildings. Each profession possesses its own terminology, methodology, specific perspective and set of knowledge about the built environment and the regulations act as interlocutor between them. Much of Dusty Gedge's work as President of the European Federation of Green Roof Associations has been to align the work of designers, contractors and developers to structure greenroofing material, design and practice to existing building regulations and standards. These are drawn together by the *GRO Code for Greenroofs* (Allnutt et al.:2011), which is based on the German Forschungsgesellschaft Landschaftsentwicklung Landschaftbau's (Landscape Research, Development and Construction Society) guidelines.

Roof Greenings

'Greenroof' comes from the German *dachbegrünungen* meaning 'roof greenings' and has altered in English convention into greenroof or green roof.[2] The most common classification is intensive/extensive (Cresswell:2007), named after the amount of maintenance they require. Intensive roofs have a deep substrate (growing medium), requiring more irrigation but enabling deeper rooted and more diverse planting such as vegetables, trees and shrubs. These roofs are used for amenity, gardens and terraces, like the Kensington Roof Gardens in London, the Reading International Solidarity Centre (RISC) permaculture roof garden, The Merril Lynch Financial Centre, one of the first greenroofs in the City of London and the internationally renowned Eagle Street Rooftop Farm in Brooklyn, New York.

Extensive roofs are more shallow than their intensive counterparts. These are planted or seeded with ground cover (low growing, shallow rooted plants) and these roofs require less maintenance and watering. While intensive/extensive suggests a definite division, the multiple variations move along a spectrum and in practice there

[2] I use greenroof throughout as I prefer the German compound.

are many hybrids with the semi-intensive roof emerging as a way of describing variations between the two types (see table below). A second, extensive greenroof: the brown/rubble/biodiverse roof developed during the 2000s in the UK. This will be considered later.

Table 5.1: Source: Gedge Green Roof training slide on Water and Energy (2009), with permission. I have added the semi-intensive.

Type of Green Roof	Depth [mm]	Vegetation
Extensive	20-40	Moss / Sedum
	40-60	Sedum / Moss
	60-100	Sedum / Moss / Herbs
	100-150	Sedum / Herbs / Grass
Semi-intensive	150-200	Grass / Herbs
Intensive	200-250	Lawns / Shrubs
	250-500	Lawns / Shrubs
	<500	Lawns / Shrubs / Trees

The GLA use a simple binary system based on the difference between "mat based systems" and "substrate based systems" intended to simplify practice for developers (2008:12). Mat based roofs are 20-40mm deep and planted with sedum and the substrate based roofs are "between 75mm and 150mm in depth, consisting of either a porous substrate or similar reused aggregates" and planted with a greater variety of plants (ibid:12). Virginia Russell of Cincinnati University has challenged the intensive/extensive division and proposes a new classification system based on regional identity, methods, "plant palettes", social, economic and environmental benefits: "green roofs will have higher orders that are more 'intelligent' because of their advanced and highly evolved sustainability measures (University of Cincinnati:2013). This has yet to materialise and for the moment, the simple classification is still in evidence.

Anatomy of a greenroof

The greenroof does not just arbitrarily offer or possess affordances, conditions and possibilities. These are deliberately constructed and assembled into its production. The layers of a greenroof include a vapour barrier; a waterproofing membrane; a water storage reservoir and a drainage or filter layer (photograph 12). They are layers of

control and protection: from water and moisture, from the roots of aggressive plants and the weather. The vapour control layer is fitted on top of the roof deck, and it protects the roof surface from water vapour from inside the building. Trapped water can produce mould, damage the roof structure and reduce the thermal performance of the building. The vapour control layer can be fitted under external insulation ('warm roof'). Pitched roofs are usually insulated internally ('cold roof') while flat roofs can be insulated internally or externally.

The principle waterproofing root-barrier layer is laid over insulation, or if there is none, directly onto the roofing surface. Waterproof root-barriers are sheets of restrictive materials such as ethylene propylene diene monomer (EPDM) polymer, polyvinal chloride (PVC), which are durable and reusable or thermal polyolefin (TPO) and geotextiles. The materials are required to be dense, strong and resistant to tearing and root penetration. This protective membrane is widely considered by respondents to be the most important technical layer. If fitted incorrectly, it can result in a leaky roof, which invalidates the whole project. Once laid, the membrane is tested to ensure its integrity and certified to qualify for insurance purposes. It is claimed to last for up to 60 years or longer. The Green Roof Centre in Sheffield as well as Dusty Gedge and John Little who run training courses together recommend pond liner for small, do-it-yourself (DIY) projects (Gedge and Little:2013). This is a heavy butyl liner sold by garden centres. For large projects, liners are pre-cut and pre-fitted with gutter and other roof furniture holes at the manufacturer's factory. One respondent I met simply laid plants onto his roof, neglecting to place the necessary supporting layers. He was confused and disappointed when all his plants died.

The reservoir layer is available as a flat mat (2-12cm) or more commonly, as a dimpled, egg box like layer (photographs 9 and 12). The egg box shapes act as a reservoir, helping to slow down the travel of water from roofs during storms. The substrate may do this to an extent too. It is constructed from materials such as polyurethane foam, plastic or polystyrene and also acts to protect from root damage. The reservoir should be topped by a geotextile filter (photograph 9) to prevent clogging by soil, substrate or plant roots and to prevent roots becoming water logged. At the time of writing, I became privy to one side of a disagreement about the installation of protective layers on the roof of four garages. The person building the greenroof did not install all the protective layers my respondent would have done. My respondent complained that the roofs were "a poor job" because of this. His concern was mediation between providing the conditions to maximise plant growth and roof protection. To neglect either is to risk a failed roof and with so much reputational cost at stake for green-

roofs my respondent did not believe it was worth the risk. The greenroof builder was thinking about cost and (in my respondent's opinion) compromising both plants and roof, possibly because they were "only garages" not envisioned to last 60 years.

Variation starts to emerge during the consideration of substrate or growing medium. The substrate layer needs to provide several affordances. It must produce suitable weightings, provide the correct level of nutrition, be permeable to water and free draining (Cresswell:2007). It should also be resistant to compaction, wind and water and act appropriately to support the plants (Gedge et al.:2011). Frequently, the roof is enhanced with drains, outlet pipes (photograph 6) and swales (photograph 9). A swale is "a posh way of saying ditch" and is a layer of stones placed between the planting and the walls, outlet pipes and other roof furniture such as skylights (Grant interview:2011). Other important characteristics the substrate must posses are lightness: both in terms of weight and of nutrition. As table 1 shows, the amount and type of substrate used is dependant on the weight a roof will hold, and this, in turn, dictates the planting a roof affords. Substrate materials can be of several types. Intensive roofs use soil because they require high fertility. The Church of the Later Day Saints building and conference centre in Salt Lake City, Utah (Church of the LDS) has a substantial soil substrate of 200mm and is capable of sustaining trees (ZinCo GmbH:2014). The Kensington Roof Gardens also feature trees and a pond, with their famous flamingos.

Experience from ecological surveys of brownfield sites and exploratory greenroof research in the UK and Switzerland (Brenneisen:2006; Gedge:2003b; Ngan:2004), suggests that using low nutrient growing substrates and maximizing the range of microhabitats will increase the diversity of species using brown roofs. Substrate for semi-intensive or extensive roofs consists of a layer of sand, gravel, clay, brick rubble/granules, perlite, stone chips, bark chips. In addition, light expanded clay aggregate (LECA) made from loam clay and compost can be used. Rockwool can also be used, but this is not common. Research links the choice of substrate to the resulting plants through the pH of organic matter and each aggregate type (Molineux et al.:2009). The Greenroof Guidelines (The Green Roof Centre:2007) indicate that not more than a 20% organic matter substrate should be used in order to keep the nutrient (nitrogen, phosphorous and potassium) content low to encourage certain species of plant (Gilbert and Anderson:1998). German regulations also recommended this in order to comply with fire regulations (Grant:2006).

Much time and effort goes into deciding how much weight a roof can take, both for new-builds and for retrofits. An ordinary tiled roof, for example, is designed

to support approximately 150kg/m² (English Nature:2003). Calculations must take into account the greenroof's fully saturated weight and possible snow weight. Failure to do this correctly could result in roof collapse. Gedge and his colleagues, in association with industrial partners have worked on greenroof weighting and calculate a lightweight sedum mat at 90kg/m²; a substrate based extensive greenroof 120-150kg/m²; paving/shingle 120kg/m²; semi-intensive 200 -250 kg/m² and intensive 300kg/m² (Gedge:2010b). Greenroof companies produce guidelines for their own products (see Optigen[3] for a good range). The Bauder 25mm geotextile blanket sown with sedum and mosses has a saturated weight of 30kg/m² and the coir fibre fleece sown with herbs, grasses, sedum and mosses has a saturated weight of 42 kg/m² (English Nature:2003). ZinCo (2000 quoted in ibid.) suggest that the wet weight of vegetation and 180mm substrate is 220kg/m². English Nature, following Scrivens (1980) suggest a total loading of >10kN/ m² for garden roofs with trees in 600mm soil, including wet weight and people. The wet weight of the 100mm turf roofs at the Centre for Alternative Technology in Powys is 500kg/m², requiring 100mm rafters for support (Kingsbury:2001 quoted in English Nature:2003). The 150mm turf roof of the Findhorn eco-village is 510kg/m2 (Talbott:1997).

Workmanship is of vital importance to the success of greenroof laying (pers. comm.). Failure of a greenroof will not be the plant's fault but will be due to the quality of workmanship involved in setting down the waterproofing and root-protection layers. One primary school in North London installed a greenroof early in 2013, and shortly afterwards erected safety fencing to enable access. However, once this was done, the roof began to leak. The building manager thought it may have been due to the excessive weight of the metalwork because after the fence was removed, leaking stopped (pers. comm.). However, it is more likely that the fence posts broke through the protective membrane, affording leaking. After several attempts to remedy the situation, the roof was dismantled. "By this time the garden was a complete mess and unusable, so the governing body decided to scrap the idea. A real shame" (pers. comm.). The matting, felt underlay, substrate and plants were all offered free through mailing networks in London.

Sustainability

Greenroof designers, builders, manufacturers and ecologists often take great pride in emphasising how 'sustainable' their materials and roofs are. While the idea of what

[3] http://www.optigreen.co.uk/SystemSolutions/SystemSolutions.html

sustainability actually is has been difficult to define (Beckerman:2008; Giddens:2009; Kates et al.:2005; Rayner:2009) differently constructed by different professions, with some (Cook and Swyngedouw:2012) even claiming it as post-political and a floating signifier. My respondents have no problem in establishing, defining and measuring what they believe is sustainable, although the process is complicated, involves trade-offs and is ongoing. Sustainability is determined through a comparative process, which is informal and varies from one person to another. It takes into account the official recognition of performance standards of materials but often stands outside official regulatory guidelines. One material is judged more or less sustainable than the next and this is then calculated against performance, longevity and recyclability.

For greenroofers, sustainability describes a relationship between materials, time and effectiveness. The correct and best materials available are employed even if these are considered, in and of themselves unsustainable. Materials which are lighter on energy in production or less toxic in construction or disposal, are considered more sustainable against materials which do the same job but are less sustainable because of a range of other qualities. For example, Woolley & Kimmins (2000) recommend a natural rubber such as EPDM compared to synthetic PVC and chlorinated polythene because of the manufacturing process and disposal.

Architect Jon Broome uses EPDM or TPO membranes because they are less polluting in production and problematic in disposal than PVC (Andrady:2003; Thompson et al.:2009). However, PVC is still considered for the reservoir layer because of its strength, lightness and longevity when shielded from UV rays. Even when PVC's high embodied energy is calculated, it may, for some, still be the best material currently manufactured. Failure of materials is traded-off against the production values, with sturdy materials winning out over shorter-lived ones.

Substrate materials such as perlite are heavy on energy in construction (Bianchini and Hewage:2012). Cresswell describes aircrete (aerated concrete) as: "highgrade use of a low grade material / waste" (2007:5). Dunnett and Kingsbury (2004) consider packed gravel the most eco-friendly solution. Correct layering provides for the production of affordances for plants and animals to thrive and to do so for upwards of 60 years. While they understand that the materials they use may be obsolete in 20 years, greenroofers balance the considerations as they are now to produce longevity: continuation and support for the newly created ecosystems moving into the future. The waterproof membranes protect the roofing surface (Ngan:2004; Wong et al.:2003) and this extends the roof's lifetime as well as conserving energy. Overall, the life cycle environmental benefits are considerable (Kosareo and Ries:2007; Saiz et al.:2006) and

the overall costs can be lower than conventional roofs (Wong et al.:2003). The issue of material conservation, not using more resources than necessary, also contributes to an idea of sustainability. John Little exemplifies this in his use of old sea containers for producing sheds and offices. He, along with Gedge and Grant also develop water retention systems to recycle water from the roof to water plants in summer.

The membrane has the potential to hold two kinds of recyclability. The first is the use of recycled materials for construction. The second is recycling the used membrane. An increasing number of companies now use recycled materials for membranes and have increased the use of solvent-free materials. John Little now uses recycled plastic and crushed brick, ceramics and waste compost. In addition he uses reclaimed timber where possible (interview:2011). One company lists its eco-credentials in terms of percentage recycled materials: at 100% are the growing media, base felt, and hard-top on their insulation board. The reservoir core is 90% and their polyester reinforcing fleece, up to 25%. The waterproofing membrane is 80% applied polyols or resins which are obtained from the seeds of the tropical castor "a renewable resource, combined with a recycled material" (Kemper:2013). Another company uses a recycled polyester/polypropylene fibre for their protection mats (Wroe:2010). These kind of claims are becoming an integral part of company selling strategies.

Claims for the recyclability of used membranes are tenuous, despite being widespread. It is not yet clear whether material in use for 60 plus years in the UK would be capable of being recycled. It is likely that root entanglement or weakening of the material would render them unsuitable for reuse and even for recycling, especially if resources were required to return them to usable condition. A recycled or pre-used liner would be very unlikely to be used because of the risk of degradation and leaking. Insurance companies would be wary of reuse. The North London school roof was easily recycled because the layers were a few months old and the plant roots not yet settled. Much of the value of recycling and reuse at the end of a greenroof's life is imagined potential.

Recycled waste construction materials like crushed brick and concrete which are used for substrates are valued over manufactured substrates in terms of sustainability. They can be moved from the ground directly onto the newly-built roof. If this is not possible waste materials can be transported from other construction and demolition sites. These roofs have developed a separate identity as rubble (biodiverse) roofs, discussed below. In the late 1990s, on early British roofs, the use of discarded industrial waste materials was considered the idea substrate, mimicking the conditions of brownfield sites. However this single material alone was under-fertile.

Rubble on the ground is a mix of building materials and soil and the waste materials alone were unable to support plant life, so a shallow (2cm) growing medium was introduced. Recent attempts to utilize used coffee granules to fertilise greenroofs (Kloosterman:2014) show that conventional substrates are being supplemented by notions of recycling and sustainability in mind.

The completed greenroof is often argued to be sustainable as a completed object. Its longevity balances carbon and pollution 'costs'. Pollutants such as nitrous oxide and sulphur dioxide which are produced from the material's manufacturing are balanced by the plant's absorptive capabilities in situ and can be equalled out anywhere from 13-23 years (Bianchini and Hewage:2012). This allows them to be thought about as moving from a calculative negative to positive. In other words: sustainable over a long-term.

Ultimately there is no particular ideological commitment to any of the industrially produced materials as there is with the plant layer. There is no commitment to particular materials other than the pragmatic business of roof and plant protection and efficiency. The materials are interchangeable with new products and materials if they prove more efficient or cheaper. The trade-offs made in the course of designing and building a greenroof mean that considerations of robustness and stability take precedence. It is the plant layer where the commitment lies. However, there is also still a huge measure of practicality involved with laying a greenroof and a roof with non- or less sustainable materials is still better than not putting down a greenroof at all because the roof as an effective configuration is itself defined as sustainable: "there is nothing, *nothing*, in green technology that does more, is as beneficial as a greenroof" (Gedge interview:2011).

Plants

The material layers are technical. They are designed, engineered and fitted to provide affordances for the plants. The important layer is the plant layer, and when greenroofers talk about greenroofs it is to this living plant layer they refer. The other layers start to disappear into a supporting role and become largely invisible once installed. The biological requirements of plants: sunlight, moisture, nutrients and a way to reproduce must be afforded by the greenroof. Greenroofers go to a lot of effort to understand these requirements, especially in connection with the challenging weather conditions to be found on roofs. The choice of planting is crucial, and it depends on

a careful negotiation between: the roof, in terms of fabric, slope and weighting considerations; the choice of substrate, which also depends on these factors and the end use.

The Rise of Sedum

The sedum blanket (photograph 1) commercialized the growth of the greenroof industry and facilitated the spread of greenroofs. Sedum (latin name *Sedum*) is a genus of plant in the Crassulaceae family and there are approximately 500 species[4] within the genus. Originating in Asia, naturalised in Alpine regions and now spread worldwide, there are approximately 25 naturalized sedum species in the UK under the common name Stonecrop. Sedum are xerophytes (arid loving plants[5] which Werthmann describes as the "workhorse of the industry" (2007:28). Sedum do not have a long history as a roof plant, but gained the reputation for mimicking the "natural vegetation of dry places" (Dunnett and Kingsbury 2004:175) and developed as the industry standard for rooftops over the last 30 years in Germany because they are wind, frost, flood and drought tolerant. Sedum have shallow roots, are low and slow growing, drought resistant and provide very little humus build-up on the roof. This means that, over time, the roof does not gain much appreciable weight. Sedum are easily propagated and produce flowers which are insect, not wind pollinated making them less irritable for allergy sufferers. As Werthmann (2007) notes, they are tidy, require little maintenance and are low cost. Some sedum are edible.[6]

Sedum grow easily in fields, on mats consisting of polyester, hessian, or porous polythene covered with a shallow layer (2cm) of growing medium. The roots entwine to form a solid 'blanket' which is lifted, cut into strips, rolled up, transported to site and either craned or carried onto the roof in a similar way as the other roofing materials (photograph 1). These rolls are laid like lawn turf, providing an instant rollout product which is lightweight and relatively fast to lay. It requires no special equipment to install, although some large companies have developed their own bespoke laying machines. While this process may be instant for the customer, it takes at least a year

[4]With some sedum having multiple sub- species.

[5]Sedum uses a type of photosynthesis named Crassulecean acid metabolism (CAM). Malic acid, which builds up overnight, is broken down the next day into carbon dioxide for photosynthesis. This means sedum pores are closed during daylight, to prevent water evaporation. In extreme conditions, pores can be closed day and night (CAM-idling).

[6]On one visit to the Sheffield University research roof, a kind respondent sought out biting stonecrop (sedum acre) for me to eat. It has a peppery taste which develops in the mouth after chewing.

to grow the blankets and often another two years to establish fully on the roof. Once created and placed, the plants are expected to preform according, not only to their genetic capabilities, but to respond to the climatic and weather conditions, the substrate and the other physical attributes of the roof. This is a confidence in nature: a confidence, which expects and hopes plants will: "do what comes naturally" (pers. comm.).

The Rise of Biodiversity

Biodiversity was officially coined in 1986 at the National Forum on BioDiversity in Washington DC.[7] It is defined, simply but unhelpfully on the one hand as 'everything' and on the other as:

> all hereditarily based variation at all levels of organization, from genes within a single population or species, to the species composing all or part of a local community, and finally to the communities themselves that compose the living parts of the multifarious ecosystems of the world (Wilson 1997:1).

The concept made biologists who had previously worked in niches into holists, working with interconnectedness (ibid). This interdependence of different life forms is one of the reasons that biodiversity is considered so vitally important. Different kinds of animals and plants carry out different functions in an ecosystem and so the more species there are, the more resilient the system should be. Climate changes are now making the "intricate webs" of biodiversity more fragile and susceptible to damage because particular plants and animals may have adapted to rely on each other for survival ("Patterns and Maintenance of Biodiversity" 2010:34). These co-dependancies are often unique with the loss of one species resulting in loss of others. This positions biodiversity as healthful: "[b]iodiversity is essential for ecosystems to function well and to provide services that are critical for human health" as well as being of service to humans (ibid). Lack of genetic diversity is recognised as disease producing e.g. the potato famine in Ireland and the recent spread of Dutch elm disease (Lohr:2013).

At the Earth Summit in Rio de Janeiro in 1992, 150 countries signed the Convention on Biological Diversity and the UK produced its first national Biodiversity Action Plan

[7] On Sept 21-24 1986, at the National Academy of Sciences and the Smithsonian Institution (Wilson 1997:1).

(UK BAP) in 1994. The concept is rooted within biological levels: the protection of genes, species and habitats (UNEP:2014) and through successive levels of governance. However, just as levels in governance are thought useful (Bache and Flinders:2005), but are overdetermined, so too are levels in biodiversity and these have persisted even within frameworks of holism and interconnectedness.

The UK BAP identified species such as carder bees (*Bombus humulis*), linnet (*Carduelis cannabina*) and bats (*Chiroptera*), and habitats including lowland meadow, wet woodland and oceanic environments, which require protection. These are now identified as 'at risk' of disappearance and subject to a period of surveying, calculating and enumerating. For LBZ, the Greenspace Information for Greater London (GiGL:2013) provides data on the different kinds of habitat within the borough and calculates that 7% falls into BAP categories which include lowland dry acid grassland, lowland mixed deciduous woodland and hedgerows (LBZ Development Plan Annual Monitoring Report 2010:82). BAP surveys enable diversity to be homogenised, enumerated and then compared *between* very different habitats such as coral reefs and rain forests (Reaka-Kudla:1997) or, in LBZ's case, ponds and lowland mixed deciduous woodland. Targets for biodiversity within and between habitats in terms of range and target species makes nature manageable and governable in new ways, but as Lovejoy indicates individual places and ecosystems "each have their own characteristic biodiversity, both in terms of numbers and composition of species" (Lovejoy 1996:7). Targets also introduce the idea of a 'failing' biodiversity which does not live up to the targets set for it.

As detailed in chapter seven, BAPs continue to be set at each level of governance. These requirements are then translated into specific local strategies through documents such as *The London Plan* which has a green infrastructure strategy producing statutory regulation for local authorities on issues such as biodiversity. National Indicator (NI) 197 relates to improved local biodiversity through the active management of local sites. Local authorities then produce Local Development Frameworks (LDFs) which localise these statutory requirements further. The LBZ Open Space Strategy (OSS) links to specific local sites such as parks and nature reserves and uses NI197 as one of the measures of success in the "Biodiversity and Green Spaces" section of the LBZ's Draft Climate Change & Environmental Sustainability Plan. The BAP provides a framework which is centred round the identification of priority species and habitats of which there are 391 Species Action Plans (SAPs) and 45 Habitat Action Plans (HAPs) in the UK (BARS:2013). An area may then be protected by planning or statutory designation e.g. a conservation area, or be identified by the Environment

Agency as providing "a significant ecosystem" (CABE 2009:33).

In this way, nature is governed through technical management. Ecological surveys (Sadler et al.:2005) count the number of species, although as ecologists will tell you, this is no easy matter because there are so many variations even within one species that identification can be difficult. When a new species is identified a holotype, an ideal specimen, is recorded and all others are judged in terms of difference against that single example (Stork 1996:43). Surveys lead to and feed into local BAP plans for single identified species and these vary from borough to borough. This makes nature actionable through policy and ecosystem creation.

Locating Biodiversity

Respondents characterise greenfield sites along with the countryside as 'monocultures'. The use of chemical fertilizers is seen as enriching the land to increase crop production (Gedge:2003b) but simultaneously poisoning it thereby decreasing biodiversity. Linking the quality of soil to the number and variety of species, the countryside is now unable to support many of the named UK BAP at-risk species, which thrive on poor sandy soils. Many of these species have found affordances on brownfield sites. The UK BAP defines brownfield sites as "open mosaic habitats on previously developed land" and identifies them as a priority habitat for conservation action (UK BAP 2007:4). A fuller definition is: "previously developed land where the remains of the permanent structure or fixed surface structure have blended into the landscape in the process of time" (PPS 3, 2011:26). They include parcels of land previously occupied by agricultural or forestry buildings; developed for minerals extraction, waste disposal or landfill purposes and abandoned railway and post-industrial sites. Redevelopment of brownfield sites require their own BAPs as a planning requirement, e.g. The Olympic Park where they are described as "urban wilds" (OP BAP 2009:13).

The recognition of brownfield sites as prime regeneration sites came during the development of London as a financial capital, centred on Canary Wharf in the mid 1980s.[8] This reversed the city's reputation as a drain on the national economy (Parkinson:2001), with its decline in population[9] and stimulated the need for new housing. Abandoned industrial sites became identified as waste ground and a primary re-

[8]The financial markets were deregulated in 1986.

[9]In 1938 London's population was 8.9 million, but it fell, post-war until in 1981 it was 6.9 million. By 2001 it was over 7.4 million (Burrows 2003:140). Irmie et al. estimate the population at 7.57 million in 2006 with projections of 8.7 million by 2026 (2008:8).

source for regeneration, in order to protect the green belt. Communities and Local Government estimated that in 2005 there were 63,500 ha of brownfield land in the UK but the amount in London is still unknown (OP BAP:2009).

Many brownfield sites in London are ex-industrial, abandoned docklands and WWII bomb sites. Many brownfield sites are polluted, but respondents characterise them as more biodiverse than green field sites (Burton:1974; Chipchase and Firth:2003) providing a:

> patchwork of habitats which are extremely varied due to the wide range of ground conditions (substrate, topography, water availability, aspect), vegetation height and varying levels of neglect (Gedge et al.:2011).

This rise of an ecological knowledge centred on brownfield biodiversity led Richard Mabey to identify them as 'unofficial countryside' because of this 'unique' combination of flora and fauna, but similar to the British countryside (Mabey:1973). Hinchliffe et al. describe brownfield sites as "not pure enough to be true and not human enough to be political, urban wilds have no constituency" (2005:645). They are forgotten, waste or potential sites, caught between categories and administrative departments, policy, planning, ecology and this has led to their treatment as "second-rate" ecosystems (Francis et al. 2012:188).

Gilbert identifies the specific combinations of temperature, rubble acidity and pollution present in brownfield sites and how they predict what will grow. Linking these to different stages of succession, they are named after the dominant plant species: the Oxford ragwort stage,[10] the tall-herb stage,[11] the grassland stage[12] and the scrub woodland stage.[13] If suitable, the ground will support trees and shrubs which move in at the later stages. Each stage attracts specific insects and, in turn, birds and mammals, forming webs of biodiversity (ibid). My respondents characterise the ecology of brownfield sites as of primary importance and they can, like Gilbert (1989) predict which plants will generally colonise particular areas.

Vastly different flora and fauna found on brownfield sites are linked to a national context, in BAPs, through identifications as "endangered", "nationally scarce" and "priority species" (Harvey 2000:92). Sir Martin Doughty, Chair of English Nature

[10]Short lived, perennial wind-borne seed stage.

[11]After 3-6 years, tall perennial herbs and biennials.

[12]Over time grasses and tall herbs predominate. The 'palimpsest effect' means that traces of the earlier stages never quite disappear (Gilbert:1989).

[13]Eventually, light wind-borne shrub seeds colonise and the succession of plants also affects the animals which are attracted to them.

in the foreword to a report by the London Wildlife Trust on behalf of the London Brownfields Forum says:

> London's brownfield sites host a wide range of animals and plants, some of them nationally rare and many of them truly characteristic of a cosmopolitan London. This 'unofficial countryside', now under pressure from development, is as much a part of the living London as Hampstead Heath, Richmond Park and Epping Forest (Chipchase and Firth 2003:2).

Gedge claims greenroof ecology is of international importance when he links them with brownfield sites: "one such site in South Essex, Canvey Wick, has been celebrated as 'the Amazonian rainforest for rare invertebrates in the UK' " (Gedge:2011a). The precedent for this kind of linkage came from English Nature, the UK Government's advisory body on biodiversity which described Shellhaven, as "England's equivalent of a rainforest" (English Nature:2003). The growing recognition of these sites as of city and national importance for regeneration and the auditing of the Black redstart led to Dusty Gedge's involvement, first as an activist and later working with developers. The development of green and brown roofing allowed developers to go ahead with regeneration and replicate biodiversity on the roofs of newly constructed and renovated buildings, under the guardianship of greenroofers: "a win-win solution" (Gedge 2003b:1).

The Fall of Sedum

Ecologists, researchers and many greenroofers have long expressed unhappiness at the lack of biodiversity provided by sedum (Gedge interview:2011; Grant interview:2011). The chief complaint is sedum's inability to replicate the diversity of a brownfield site. In a conference paper he gave in Chicago, Gedge referring to some (then) recent studies, says:

> The studies show that green roofs do have intrinsic value for nature conservation but that sedum mats, which many architects wish to use as mitigation for Black Redstarts, are not as biodiverse as sometimes suggested by some in the green roof industry. This is a point that some members of the London Biodiversity Partnership have been contending for sometime (2003b:6).

More recently, refreshed claims of sedum as "a bit of monoculture" (Gedge:2013a) are starting to become more widespread. This claim is also an economic one as Dusty and others earn their living by designing and installing biodiverse roofs. However, the idea of biodiversity as inadequate is appearing in the wider scientific research (Blanusa et al.:2013). For example, the Waitrose sedum roof, in London which attracts 10% of nationally important spider species and stands in contrast to the biodiverse Barclays Bank roof, also in Canary Wharf, which attracts nearly 20% (Gedge et al.:2011).

This imperative for plants to be as efficient as possible is described by Scott MacIvor, at York University in Toronto: "The problem is that sedum plants aren't really performing on green roofs … They're just there" (MacIvor quoted in Kraft:2013). A joint research programme between the Royal Horticultural Society (RHS) and the Universities of Reading, Sienna and Sheffield compared a random mix of four sedum (*album*, *spurium*, *acre* and *sexangulare*) to three broad-leaved perennial plants: *Bergenia cordifolia*, which has large, waxy leaves, *Hedera hibernica* which has leaves with thick epidermis and *Stachys byzantina* which has leaves with light-coloured hairs. The broad-leaf plants were more thermodynamically effective (they cooled the air better) than the sedum species (Blanusa et al.:2013). MacIvor and Lundholm (2011) found that a roof in Nova Scotia planted with a mix of non-native sedum and native plants performed best for temperature control and water capture.

With the emergence of a greenroof industry many regard the marketisation of the sedum blanket as a one-size-fits-all solution: "better than nothing" and "a good start" (pers. comms.). Greenroof companies are now developing product differentiation. Pocket habitats are movable sacks able to be individually seeded/planted.[14] The grey2green Conservation Blanket™ was developed in conjunction with Gedge of Livingroofs.org and Bauder's wildflower blanket was developed with LBZ officer Frank's ecological expertise. This is something he is extremely proud of.

Affordances as Benefits

> Perceiving an affordance is to perceive the relationship between oneself and the outside world (Gibson 2000:55).

In addition to the material production of affordances for ecosystem development and the creation of nature, greenroofs also exhibit a number of other affordances which

[14] Used on the roof of the Crystal Centre's ecology building, in London.

respondents classify and describe as ecosystems services (ESS). These affordances are benefits for humans in the management of the built environment. While biodiversity stands at the heart of their project, they persuade architects, planners and developers through positioning ESS as benefits which accrue for humans. Greenroofs have their affordances intentionally built in, although some are unintentionally incorporated. They are constantly in the process of affording: enabling, providing, making possible agentive capabilities. Not always present and not always available, changing and varying over time, they are effective. 'Good' or 'bad' affordances come through human judgement, not from any quality of affordances. Some are latent and some active at different times, always rising and then falling under particular relationships of power and control (or lack of it).

In this section, affordances are described as: **attenuating** (water); **absorbing** (noise, air pollution, water pollution); **protecting** (roofs, plants, animals, birds and people from heat, cold, weather changes, damage, predators, death, climate change etc.); **repelling** and **attracting** (humans, insects, birds, animals, plants); **adapting** (to climate change, to compact city form) and lastly **producing** (nature, biodiversity and space, through policy, building, laying, and neglecting and producing utopian people, through governance, policy, recreation, exclusion and inclusion).

> The information for an affordance is to be found in events that include the relevant environmental features, the activity of the organism, and the consequences that ensue as well as the relations among these. Studying this complex of events is the means of finding the information for perceiving an affordance. (Gibson 2000:54-55).

In England, especially in the southeast there is now less overall rainfall but more heavy storms (English Nature:2003; GLA:2008). Roofs are designed to repel water quickly and storm water pours off the roof and gushes into the drainage system[15] (GLA:2008). Too much storm water overloads the system. The ability of greenroofs to attenuate this storm water within the substrate and retention layers takes strain off urban drainage systems. Some claim water runoff is reduced by 14% (Beattie et al.:2003; Bengtsson et al.:2005; Carter and Jackson:2007; Mentens et al.:2006). Many suggest that greenroofs can provide an improvement in run-off water quality (Beattie et al.:2003). Graham and Kim suggest that Vancouver's: "natural hydrologic conditions in terms of flood risk, aquatic habitat, and water quality" could be restored by retrofitting all the city's buildings with greenroofs (2003:99).

[15]This is also exacerbated by the increase in hardstanding and hard landscaping over the past 30 years and the increase in underground rooms, garages, storage etc in London.

Currently the Sustainable Urban Drainage System (SUDS) agenda is benefiting from policy and funding attention in London, driven largely by necessary repairs to the deteriorating and overloaded Victorian sewerage system. The government and the city have limited funding to fix the rotting infrastructure, so any pressure that can be taken off the system; slowing down water flow is considered beneficial. Grant funding and ease through the regulatory systems encourage this.

A similar affordance to attenuating (holding and releasing), is absorbing (holding and keeping). The materials and the growing medium in combination absorb low frequency sound waves and the plants block higher frequencies (Kalzip:2001a).[16] The Green Roof Centre in Sheffield laid a greenroof on Sheffield University's new music building citing these benefits. There is some suggestion that, because vegetation is known to absorb electromagnetic radiation, that greenroofs may be useful for this (English Nature:2003). Plants also retain impurities from rainwater (Beattie et al.:2003; Berndtsson:2006) freshening the runoff and lowering water treatment costs (Allnutt et al:2011). They also reduce the airborne particulates[17] nitrogen dioxide (NO_2), sulphur dioxide ($S0_2$) and carbon monoxide (CO) by absorbing these gases through their stomates (Ngan:2004; Niu et al.:2010; Rosenfeld et al.:1998).

Particulates also adhere to leaf's sticky surfaces (Currie and Bass:2008). Gaseous pollutants can dissolve and are sequestered by the stomata of leaves and Johnson and Newton (1996) estimate that 2000 m^2 of grass on a roof could remove 4,000 kg of particulates. Studies produced by modelling (Currie and Bass:2008) and by measurement of roofs in situ (Speak et al.:2013) all suggest that they are capable of air-borne pollutant mitigation. Andrew Speak even suggests:

> Future research could uncover some 'superplants' - pollution-busting species which provide enhanced removal rates as well as the other green roof benefits such as localised cooling, rainwater retention and of course, looking great! (ibid).

Appendix II of the *City of London Air Quality Strategy 2011-2015* (Duffield:2011) lists tree species in categories of effectiveness in tacking air quality. Air quality is particularity poor in London (ibid) and during 2013, the GLA started to fund innovative solutions for air quality management.

[16] Gedge (2012)) summarizes their findings as: Standard Unvegetated 33dB; Vegetated [dry] 41dB; Vegetated [wet] 51dB; 100mm Concrete Wall 43dB.

[17] Measured by the PM10 standard where PM stands for particulate measurement and 10 = 10?μm or less.

Greenroofs attract a substantial amount of flora and fauna such as foxes and cats (Johnston and Newton:1993); native and rare plants, bees (see Gedge et al.:2011); soil fungal communities (McGuire et.al.:2013); bats (Newton and Early:2007) and invertebrates (English Nature:2003); many of which have dwindled in recent years (Newton and Early:2007). Kadas (2007:28) predicts that many species such as house sparrow, blackbirds, gold and greenfinches, pigeons, house martins and wagtails could use greenroofs for foraging and nesting. Greenroofs offer the affordance of nesting for the Black redstart. The redstart is a ground nesting bird and it takes advantage of the elevation and isolation of greenroofs which also offer protection from predators. A similar story is reported for bats whose tree and cave habitats become replaced by features in the city and a recent study confirms the value of greenroofs as new feeding grounds (Pearce and Walters:2012) although more research is required in all these areas.

While the greenroof is attenuating water, it is simultaneously protecting the roof surface from water. The rapid, frequent and extreme temperature changes a roof normally goes though weaken the surface until it cracks and affords leaking. In addition, the membranes and greening afford a barrier to UV rays in sunlight which, over time, also have a deteriorating effect on exposed roofing materials (Allnutt et. al.:2011). Protecting the roofing surface will double or more than double the life of the roofing materials (Ngan:2004; Wong et al.:2003). Once properly installed, many predict a greenroof is viable for at least 60 years with examples, such as the Moos roof (chapter nine) still viable at 100. It is difficult to overestimate the importance of roof longevity as a key argument for installation, especially in times of austerity (chapter eight).

Greening insulates the inside of the building from the extremes of external heat and cold (Barrio:1998; Kumar and Kaushik:2005).

> A green roof acts as a heat sink, slowly absorbing and holding energy from sunlight and releasing it when the ambient air cools. In this way, it acts as a heat storage battery and reduces the heating and cooling demands within the building. Energy savings will be greatest in low buildings, due to the high ratio of roof area to the total of exposed building skin (Meir Roofing and Insulation Supplies:2013).

Buildings are warmer in winter and cooler them in summer due to evapotranspiration (Compton and Whitlow:2006). Burnett Parsons conducted a short analysis of the Barclays Bank building and concluded that:

there has been a noticeable difference in the environment on the mechanical level, situated directly below the 'green roof.' The temperature has noticeably stabilized throughout the year as follows.

1. During the summer months the temperature remains at a comfortable level. Before the 'green roof,' mechanical level ventilation fans often ran to keep the area cool. The ventilation system is now not required to operate.
2. Winter months required the heating of the mechanical level. Heating is now not required (Velazquez:2004).

Castleton et al. (2010) also claim greenroofs reduce energy use in buildings, something Gedge claims is due to 65% of the net radiation changing to evaporative cooling (Gedge:2011b). This may help alleviate the urban heat island effect (UHIE) where solar radiation and anthropogenic heat is trapped by the density of buildings and hard standing (Mavrogianni et al.:2011). London can be up to 5° warmer than surrounding countryside (Krayenhoff and Bass:2003; Onmura et al.:2001). Reports indicate that increased summer temperatures of 4.28C on average, in Southern England, will exacerbate the increase in energy demand for air-conditioning, carbon emissions as well as health problems (Mavrogianni et al.:2011). Cooling the urban environment, therefore, is of vital importance and in some cases a lifesaving benefit, as the 2003 heat wave saw a 17% rise in heat-related deaths in England and Wales (Kovats et al.:2006). A short study on social housing in London concluded that the rooms under the greenroof were up to 6° cooler in summer than their non-greened neighbours (Ray:2010). In summary, all the affordances act simultaneously and increase the effects of each other in multiple, complex ways.

All the advantages derived from greenroofs for human benefit are argued to be due to the protective nature of greening, including the material layers. This is a pragmatic approach to evaluating greenroofs in order to improve their performance. These benefits have been shaped by university led, peer reviewed research and have been incorporated into training courses and books about greenroofs. They all have to be revealed and quantified by research, my respondents argue, to be incorporated within policy and governance.

Affording Ecotopia

Staking a claim to the business of selling greenroofs can be lucrative. By 2011 the worldwide greenroof and green wall market was worth U.S. $5.3 billion and is estimated to grow to a U.S. $7.7 billion market by 2017 (Lux Research in Environmental Leader:2012). This represents over 30 million m^2 of greenroofs since 2000 (Gedge:2013a). The claim on financial savings due to energy benefits can slo be significant. The Possman Cider Cooling and Storage Facility in Frankfurt recovered the greenroof retrofit cost in 2-3 years, estimating that savings were worth approximately £4,300 per year (Gedge and Firth:2004). Velazquez (2004) notes an estimated saving in electricity consumption for the Barclays Bank building, in London, at approximately 25,920 kW per year.

The multiple benefits outlined above are envisioned as offsetting the cost of a greenroof, especially over time. Many of the earlier roofs cost a lot of money. In the early 2000s, English Nature estimated the costs at: "USA $150[£100] - $200[£133] /$m^2$ Germany 20-40 Euros/m^2 and UK £85 - £93/m^2 (Gedge and Firth 2004:27). However, in 2004, the average cost of four sedum greenroofs in the City of London was £121/m^2 with the Laban Dance Centre skewing the averages by costing £26.86/m^2 (ibid:26). Later UK greenroofs, due to economies of scale, cost from £60m^2 - £100m^2 for extensive roofs and £100m^2 - £140m^2 for semi intensive or intensive roofs (The Green Roof Centre:2013).[18] These costs vary and depend on variables such as size, height of roof, type of greening and maintenance. Larger roofs cost less per m^2 but higher roofs cost more because of crane and scaffolding hire. Sedum plugs cost less than mats, but establishing them requires more maintenance over the first couple of years. Having liner cut to accommodate roof furniture such as outlets, hatches or roof lights increases the cost as does installation of fall arrest systems[19] and railings.

> it is cheaper in the long run because it sort of, with green infrastructure, it kind of stays around for ever and all you have to do is potter around and de-silt it, but with grey infrastructure, every 140 years you have to dig the whole street up, which is what is happening with the Victorian [sewerage system] (Gedge interview:2011).

[18] An extensive greenroof in British Columbia, Canada cost approximately $130/$m^2$ - $165/$m^2$ $12/$ft^2$ - $15/$ft^2$) in 2012 and an intensive greenroof now starts around $540/$m^2$ ($50/$ft^2$) (Bianchini and Hewage 2012:58).

[19] This is a system installed where there is a high risk of falling off a roof. A permanently installed safety system is attached to the roof. Anyone on the roof is required to wear a full safety harness and this is attached to the system to prevent hitting the ground. Certified training is required to use this system.

The benefits of reducing longterm energy costs can be as much as 40 to 70% in earth sheltered houses compared to above-ground structures (Johnston and Newton:1996).

Many energy saving claims are based on modelling and not real-life in situ situations. In addition, many of the claims do not have a 'before' calculation to base any comparative figures on. The Barclays Bank building, for example, was a new building, so no 'before' analysis of running costs are available. The energy savings of 25,920 Kw per year are an estimate and it is unclear how much of an estimate this really is. Tom and Frank often mention a lack of 'before' statistics as a drawback when making claims about the energy savings of eco-houses, which are often inadequately evaluated before renovation.

Standardising and Resisting

The development of sustainability within the building industry has been an opportunity to reassess the quality of building practices and materials. The attempt to incorporate greenroofs into these systems, however, calls into question the idea of standards. Currently, there are two major codes: The Building Research Establishment Environmental Assessment Method (BREEAM) and Leadership in Energy and Environmental Design (LEED). BREEAM is the UK 'best practice tool' developed since 1990 to exceed statutory requirements (Kirkpatrick:2010). It is a system for evaluating the environmental impact of a range of buildings and involves evaluation of performance standards for materials and practice at both the design and post-construction stages. It uses "recognised measures of performance, which are set against established benchmarks" (BREEAM:2013). Sustainability is contained within materials and their regularization and expression in terms of a scale of performance. BREEAM will only consider greenroofs for general habitat creation or replacement. The UK Code for Sustainable Homes (DCLG:2006) does not yet consider greenroofs in connection with the management of surface water run-off, but this may change soon with the evidence currently being gathered by University of East London in connection with Drain London (chapter eight). Points are awarded for energy and CO_2 emissions, water, materials, surface water run-off, waste, pollution, health and wellbeing, management and ecology, with ratings for the building as a whole, in six categories from unclassified to outstanding (ibid).

Formed by the United States Green Building Council, the North American LEED system also relies on the evaluation and rating of buildings in terms of environmental

impact (US GBC:2013). Terms of evaluation are slightly different to BREEAM. LEED takes into account interior and exterior design and construction, maintenance, energy use and placing of the building within its neighbourhood in terms of travel, open space and amenities. The system allows a building to accrue points in several main categories which include: water and energy efficiency, materials and resources and indoor environmental quality (US GBC:2013). LEED is often referred to by greenroofers as a framework which could potentially inform a UK greenroof code, because it allows greenroofs to accrue points for biodiversity and energy savings, although not for carbon capture and sequestering. BREEAM currently refuse to recognise greenroofs in technical terms because they argue that plant materials are so variable that data on performance and carbon calculation is simply not currently possible. They suggest that any energy benefits will come from the insulation materials and that the greening aspects of the roof should be ignored.[20]

Greenroofs defy total technical management, despite vigorous attempts at this. The inherent unpredictability of plant material lies in the variation of individual plants ability to grow differently in different conditions, and through the self-seeding of other plants onto the roof. This results in continual and sustained resistance to standardisation. There have been several unsuccessful attempts at carbon sequestering analysis and BREEAM currently refuse to recognise greenroofs in these technical terms. However, for businesses keen to develop a sustainability strategy, carbon calculation is of vital importance in their cost/benefit analyses. Dusty uses the calculation of 375g/m^2 per year for a standard sedum blanket when he consults and gives training courses (Gedge:2011b). A study by Kidip for the firm of Kalzip calculated that their Nature Roof will take up 14.15g/m^2 of CO_2 and release 9.68g oxygen (O_2) per day, significantly more than Dusty's calculation (2001a).[21] However, as Kidip admits, calculations are 'optimistic' because the variability of the plant's multiple leaf surfaces (ibid).

While studies from Germany and elsewhere (GLA:2008) suggest that fire is not a risk for greened buildings, insurance companies in the UK are often reluctant to provide cover. The standardization of the non-living material layers, the use of relatively uniform sedum mats and the science of fire testing is helping to change this. Fire trials were undertaken in 2011-12, but I was, unfortunately, unable to attend. A Youtube video (LiveRoof:2008) gives a good idea of what is involved.

The ability of the greenroof to afford standardising has resulted in plant-life being

[20] These codes are developing continuously and may already be out of date at time of printing.
[21] They suggest that this is optimistic because plants will have multiple leaf surface cover (ibid).

coded into policy, law and research, quantified in many ways. The development of codes and standards is one of the aims of the greenroof network. Respondents view this as important for incorporation into a highly regulated industry, to promote professionalism and to draw together the diversity of competitive industries involved in this growing market. As Dusty says: "sustainability is being run by carbon dioxide, by energy, and greenroofs don't sit very well in that model of sustainability. Dictated by economic model" (interview:2011). Several important aspects of greenroofs remain elusive to quantification. This has not been a major hindrance to their uptake, suggesting that the systems of governance and of standardisation are not as impenetrable and hegemonic as many activists tend to believe and that the benefits are so generally recognised now that they outweigh at least some technical considerations.

Conclusion

While Lorimer (2008) suggests a neat alignment between the principles and practice involved in the greenroof network, as this chapter demonstrates, there have been compromises, inconsistencies and double takes. The greenroof is a category of planted or living roof where there is a great variation of form, with some argued to be more productive of an authentic, biodiverse nature than others. However, all are designed to produce the best conditions for plant growth. A properly considered, built and laid roof offers plants the affordances to grow and reproduce. Plants will always grow towards the easiest, most comfortable condition and often beyond their minimum needs and wants, towards a state of maximisation or optimization. This phyto-materiality is the agency which greenroofers understand and use. In return, plants are expected to grow and provide affordances to humans in the form of ESS, through which the urban built environment of London is increasingly managed.

The development of biodiversity and ESS as enabling discourses both encompass and resist processes of standardization. While these codes and standards shift and shape the way governance of the built environment is conducted (Rydin:2010b), the introduction of variable and resistant plants as a building material is also altering the way the codes operate. Phyto-materiality proves more elusive to this kind of quantitive evaluation but this has not hindered the greenroof's inclusion into policy and building schemes.

6

Ecotopia: Ends in View

> "The nature, which we have on our roofs, is a piece of earth that we have killed so that we could build a house on the spot.." F. Hundertwasser[1]

In this chapter, phyto-materiality affords the means and the ends-in-view of London, as an envisioned ecotopia. Ecotopia London is a vision of a vegetated city,[2] one which can be governed and materially produced through policy and practice. This vision is an alignment between the environmentalists of the wider greenroof network and the policy makers, made visible through concerns such as compact cities, health and well-being, and the enabling discourses of biodiversity and wildness, through which problem-solving can operate.

This chapter asks the question: what affordances form the condition where ecotopia can be imagined and lived? The answer lies in the way a vision of ecotopia materialises through one of the guiding inspirations of the greenroof network, the artist Hundertwasser (1928-2000). His influence will be examined through three major

[1] I have spent many hours trying to track down the citation for this quote, without success. It may be that it is in an obscure letter, or that it is informally translated. What is anthropologically significant is that it is reproduced widely and that authenticity through verification of the reference is irrelevant to respondents. Hundertwasser has described this idea in so many different ways which are directly attributable that it seems plausible enough that he said this. In the end, only I am concerned with finding the source.

[2] Not pictured due to copyright restrictions. See http://www.london.gov.uk/sites/default/files/living-roofs.pdf

themes. Firstly, a footprint replacement (FR) philosophy proposes that nature has been displaced by buildings and that these then become appropriate places to re-position or re-place plants. Secondly, ecotopia becomes more than replacement. It is an active, engaging and agentive nature, creating new configurations and relationships between the human and non-human. Greenroofs establish the conditions for the ectopian and are implicated in processes of 'dwelling' in the Heideggerian sense. Lastly, these phyto-material entanglements form a healing synergy appear through two conditions: nativeness and isolation which weave together to create the conditions under which an ecotopia for flora, fauna and human life is possible.

Hundertwasser

Hundertwasser's architectural style and philosophy suffuses the greenroof movement in London and worldwide. He is widely quoted in print (GNInsulation:2009; Preisler:n/d.; Proefrock:2007; The Horticulturist:2008) and in training days, seminars and informational sessions. This is usually in the form of the quote above accompanied by a photograph of the Waldspirale: Forest Spiral of Darmstadt.[3] Dusty refers to Hundertwasser as: "[a]n inspiring person. And all his roofs are there to inspire the designers, ecologists and green professionals of today and the future" (Gedge:2010a).

Born Friedensreich Stowasser in Austria, Hundertwasser was an eclectic artist who expressed his ideas through painting, applied art, tapestries, graphics, stamps and, of interest to greenroofers, architecture. He was also a founding member of the Austrian Green Party. The central problem Hundertwasser identifies is the relationship between society to nature in terms of 'dwelling' as Heidegger (1993) describes it. Cities and buildings appear to reinforce a separation between people and nature, preventing true dwelling:

> in our modern functional architecture, allegedly constructed for the human being, man's soul is perishing, oppressed. We should instead adopt… wildly, luxuriantly growing architecture (Hundertwasser 1958:1)

Hundertwasser's philosophy and buildings express a fluidity of form and his use of extensive planting is much more pronounced than his contemporary, Antoni Gaudí (1852-1926), with whom he shares a similar flowing, nature-based architectural style.

[3] http://www.pinterest.com/pin/157766793166331070/

Advocating self-build for everyone, Hundertwasser railed against his contemporaries such as Le Corbussier[4] and the 'straight line' which be saw as emblematic of rationalism[5] (ibid; Rand:2003; Restany:1998) and the antithesis of nature and the natural: "[t]he tyranny of the straight line, the mother of all evils, the mother of uniformity and ugliness" (Restany 1998:18). Ironically, Le Corbusier (1887-1965) and his contemporary Frank Lloyd Wright (1867-1959) among other leading architects of the early to mid 20th century, developed a similar 'footprint replacement' philosophy where lost ground is literally replaced by greenroofs and gardens on the 'fifth elevation' (Reed:2005). Osmundson's (2000) greenroofs, sky-gardens and social and public roofs continue this tradition well into the 1970s.

By contrast to the lifeless city Hundertwasser suggests: "[t]he true proportions in this world are the views to the stars and the views down to the surface of the earth" (Hundertwasser quoted in Dunnett et al.:2011). He describes how plants go into the design, as an integral element, rather than *onto* the design as a landscaping element and which is easily removed. Consequently, the active habitation of buildings by both people and plants is vital to a restorative, cooperative dwelling. "Roads and roofs would be planted with trees. It must be possible to breathe forest air in the city again …" (Hundertwasser quoted in Rand 2007:146).

The rejection of rationalism and the Modernist aesthetic is one which figures widely within the contemporary greenroof network in London, but it is tempered with the pragmatic; the need to get greenroofs laid in response to climate change. Modernist and Brutalist roofs such as the South Bank Centre,[6] the Barbican and Mill Lane Community Centre (discussed below) were often explicitly designed for roof gardens. They still offer this potential as the strongest, flattest, most appropriate surface for greenroofing. In many ways this is an ironic and interesting rapprochement between the kind of straight-lined building emblematic of rationalism and the greenroof's idealistic, wild-grown 'natural' Romanticism. It is a reinvigoration of the utopianism envisioned by the modernists, where design, technological and scientific knowledge, underpinned by abstraction, a machine aesthetic and democratic principles (Gelernter:1995) transform society.

[4]Charles-Édouard Jeanneret-Gris.

[5]69 - the whole of his Jewish family were killed by the Nazis.

[6]The new designs for the reinvigorated centre also feature expansive roof gardens.

Footprint Replacement

When one creates green roofs, one doesn't need to fear the so-called paving of the landscape: the houses themselves become part of the landscape. People must use the roofs to return to nature what we unlawfully took from her by

> constructing our homes and buildings - the layer of earth for grasses and trees (Hundertwasser quoted in Gedge 2008:6).

Malcolm Wells, an American architect who builds earth sheltered houses (Wells:2009) adopts a footprint replacement philosophy and like Hundertwasser, his influence can be noted throughout the greenroof network (Grant:2006; Grant and Lane:2002). Gary Grant was an early adopter of footprint replacement when he represented clients using the architectural firm Architype who employ this philosophy. Jon Broome, author (2007) and founding director of the company asked Gary to design the greenroof on his self-built house in South London in 1993. It was seeded with wild flowers and grassland seeds. Justin Bere, of Bere Architects also built an early greenroof on his house in South London. Bere's roof has four distinct sections, two wild flower meadows, a hawthorne thicket and a hazel coppice (Bere Architects:2013). One section for wildflowers features lawn turf, which had been "rescued from the building footprint, was placed upside down (to promote plant colonization) on a framework of wooden battens" (Grant:2006). Footprint replacement has started to be adopted by contemporary mainstream architects such as Vincent Callebaut who designed the forthcoming Agora Tower, in Taipei, Taiwan (Kostadinov:2013) and Rafael Vinõly who designed 20 Fenchurch Street ("The Walkie Talkie") in London. Norman Foster says:

> I always think that it is somewhat tragic that when you contemplate the view of any city from a high-rise building that the possibility of recreating the ground level site at the top of a building is generally squandered (Johnston and Newton 2004:67).

The Roots of Bluebell House

For most of their life together, Jeff and Elena owned and lived in a large detached mid-Victorian house, in South London. Several years ago they started planning for their retirement. As a result, they built a bungalow in their large, mature garden, and

this is where they live now. The house is hidden behind a row of houses and accessed by a long driveway. It borders onto tennis courts and fills the plot almost completely, backing up to the hedge at the rear of the house. The house is long, and low one storey with a second story in the middle section where the master bedroom stands on top of the living room in the middle of the house (photograph 8). The living room divides the garden plot into a small garden with pond on the entrance side and a similar sized private terraced eating area with extensive planting on the other. Sustainability is a significant feature of both the house and the owner's personal identities. Elena discusses this as a holistic philosophy, and the architect was chosen because they "shared a vision" (pers. comm.).

The house is clad in wood and is extremely energy efficient. The glass is triple glazed, and the only heating is a solid fuel stove in the living room. The windows stretch from floor to ceiling to allow as much sun as possible to flood in. The rooms are protected from overheating in summer by movable wooden shutters which slide open, enabling the outside and inside to mingle. The house sits in the old garden, resting on piles which were placed in order to avoid the existing tree roots. The whole house sits easily in the site as if the trees had grown up round it. Before the build started, Jeff and Elena lifted the bluebells from what was then their back garden and replanted them on the roof, giving the house its name. The greenroofs run across the entire length of the property and they consist of a sedum mat on the high and inaccessible section and a much more varied planting on others. The roof is visible from different rooms and vantage points both inside and outside. The bathroom looks out over the roof of the storey below with its wildflowers and bluebells in spring. The door on the upper landing allows access to the walkway which runs the entire length of the back of the house for access to the plants. The roof and garden change differently throughout the seasons. The long grasses and scraggly plants on the roof are not tended, cut down, shaped and managed as are the garden plants.

The way the roof interacts with the quotidian living spaces is in direct relation between resident, roof and building, much like Hundertwasser envisioned. This house is typical of other private build eco-houses. Elena finds nature exactly in the places she wants it to be and will not brook any discussion on problems with the greenroof. This may be because the roof is new, because there is so much at stake for her personally, or perhaps it is the level of control she exerts over the physicality of the building. Many architects and self-builders, such as Jon Broome and John Little have the ability and confidence to manage technical and physical difficulties with greenroofs and often do not interpret problems in the same way as others. This is a particularly no-

ticeable feature for those who see their mission as one of 'conversion' to sustainability, climate change or eco-friendly living. They will not admit to problems.

Jeff and Elena's house illustrates precisely how the original ground which is to be displaced through house building can be re-placed on the roof. Personal identity for Jeff and Elena becomes intwined with the ground, soil and plants which make up the history of their old garden. This becomes the ground on which they shape of their house for the future. Replacing the footprint of the 'original' ground before development and then taking a "lets watch and see" approach, as one invertebrate researcher describes it, allows native and local plants to take over and colonise green-roofs. This strategy also speaks to the wider austerity which is shaping the UK's parks through the use of plants such as grasses and shrubs which tend to be low maintenance, with a developing expectation of aesthetic attraction, taxonomic diversity and wildlife support (Dunnett and Hitchmough 2007:1). Groups, charities, researchers and local authorities shape their plants to their financial situation.

Footprints in London

As Rydin (2010b) suggests, *The London Plan* is above all a spatial strategy, attempting to govern the increasingly dense city. *The Cities and Biodiversity Outlook* survey of world-wide urban populations concludes: "the total urban area is expected to triple between 2000 and 2030" with "[m]ore than 60 percent of the area projected to be urban in 2030 yet to be built" (SCBD 2012:7). The 2010 figure of 3.5 billion urban dwellers (just over 50% of the world's population) is forecast to increase to 6.3 billion by 2050. Agenda 21 also identifies cities and their specific systems of governance, through planning and policy, as of key importance in managing climate change (UNCED:1993). The sustainability team officers at LBZ consider the frameworks which link levels of governance developed from Agenda 21 as of enormous influence within the local authority.

The London Plan seeks to develop London by linking population, city growth and the built environment and encourages tall, large-scale and intensively used buildings, arguing that a compact city can and should be a sustainable and iconic one (Tavernor:2007; Tavernor and Gassner:2010). The compactness and proximity of cities both demands and enables governance of problematised environmental issues such as water, energy and air quality. The built environment, identified as a problem through the appropriation, not just of territory, but of 'nature' itself, becomes the site of the solution (Dickson:2012) under a footprint replacement philosophy.

Cities enable different scales, interests, ecologies, financial and cultural interests to intersect and interact. The economic, technological, chemical, environmental, ecological, social, living and non-living mix in close geographic proximity. People and resources are redistributed constantly: "[u]rban systems are 'flow-through systems' … energy and material fluxes" (Richter and Weiland 2011:1953). Cities enable multiple publics to form in order to problem-solve and then dissipate when no longer necessary (Young in McKenna 2002:132-3). As Cooper-Marcus and Francis (1997) remind us, cities are where most people will encounter 'nature'. Cities enable multiple ecosystems such as the 'gardenesque', (gardens, parks) to exist in close proximity to 'technological' habitats, (interacting with industrial materials) and 'ecological', "where natural elements are allowed to function in a natural manner" (Gilbert 1989:2). Whether through "piecemeal" private and local authority creation, "encapsulated countryside" or on "informal" brownfield sites which exhibit local character and have low/no design element or management, these ecosystems work in synergy (ibid:2).

The cityscape still contains untapped potential. By redefining roofs on paper and in the imaginary as "visually 'dead' and unappealing" (Gedge:2014), "wasted spaces" (Sharp:2008), as "some of the capital's most underused assets" (PoliticsHome:2006) or in the US, as the "last urban 'frontier' " (greenroofs.org:2012), they move from being roofs to roofscapes. Their moral characterisation as wasteful and underused, makes them available as spaces envisioned and redeemed through possessing potential. Their newly found visibility is 'made up' and quantified as 24,000 hectares or 16% of Greater London which can be greened (Grant:2006). Gedge states: "[t]here's 24 times the size of Richmond Park in flat roofs in London, which could be green tomorrow" (LSDC:2008). The Chartered Institution of Building Services Engineers estimates 200 million m2 of potential roofscape across the UK (CIBSE:2007).

Many respondents hold the notion that cities have destroyed nature and simultaneously that nature cannot be destroyed. When convenient, they argue that cities have replaced the 'natural' or 'original' environment such as grasslands (pers. comm.). As Hinchliffe (1999) points out the nature in cities, despite being a constant traffic of the vitalities and rhythms of plants and animals, remains largely invisible and ignored; "a shadow population" (Wolch et al.:1995). This enables respondents to describe the city as lacking nature, driving it out, or otherwise destroying it (Hinchliffe:1999). However, at other times they argue the opposite:

> I just find an ideology that proposes we have killed nature in cities too negative - and impossible!! It makes people feel like they are having to

> start from scratch and in a very hostile environment - the stories our cities tell us about nature thriving alongside (in spite of) development I find a more compelling story (email. comm.:2013).

This is a nature which has been trampled, but is resistant, breaking through, taking over, or claiming back; typified by photographs of plants growing in cracks on the pavements which regularly circulate through Facebook pages under captions such as "Nature's artwork," "Nature will reclaim" and "Nature always finds a way."

Hundertwasser's proposition that cities are devoid of nature is not borne out by contemporary statistics and research. The total amount of the UK which is built on (including roads) is only 6.8%. 56% of the land in towns and cities is given over to green-space, with an additional 18% for domestic gardens and 6.6% for canals, lakes, rivers etc (Easton:2012; Watson:2011). Nature is controlled, planned, regulated and carefully situated in 'taskscapes' where practical tasks are "carried out by a skilled agent in an environment" (Ingold 2000:195). Gardeners simultaneously manage biological, technical and social agencies (Cresswell:1997; Hitchings:2002). Nature here is believed to be natural despite the control exerted over plant life (Tilley:2009).

London is a particularly 'green' city with over 2000 parks, some of which are very small squares or plots, and there are many thousands more gardens:

> LONDON'S PARKS AND GARDENS COVER MORE THAN TWENTY-FIVE PERCENT OF THE CAPITAL - THAT'S A LOT MORE GRASS BETWEEN TOES THAN ANY OTHER CAPITAL CITY IN EUROPE (Ocran and Gilmour 2010:front cover. Uppercase in original).

While GiGL (2013) calculate green, open space as more than 40% of the total land area of London this does not, for respondents, equate to biodiversity. City parks and gardens are often characterised by them as lacking biodiversity although, again, the research contradicts this. Cities and towns often have more ecological species per square foot than countryside:

> about a third of British insects are expected to visit a 0.6 ha garden in Leicester, and interwar housing is considered to support a higher density of breeding birds than the richest deciduous woodland (Gibson 1998:5).[7]

[7] He means insect species, not the total number of individuals.

The City of London alone contains over 300 open spaces of which 10 have been identified as Sites of Importance for Nature Conservation (SINC)" (Wynne Rees 2010:101). The Thames Estuary is especially important as habitat (Harvey:2000) with invertebrates listed as rare in the UK BAP species (GLA:2002; UK BAP:2007) such as the shrill carder bee (*Bombus sylvarum*) and the brown banded bee (*Bombus humilis*) (Kadas:2007). The decline of the bee population in the countryside is due to an estimated 97% loss of wildflower meadows in the UK since 1930 (Fuller:1987; Gedge et.al.:2011). By contrast, urban bees are thriving, because of the wide variety of nectar producing city flowers. The recognition of successful urban wildlife is argued by greenroofers to support habitat for endangered wildlife and the need for the greenroof as an urban form of footprint replacement.

Brown Ecotopias

Plans for a compact city rest on regeneration and turn full circle to brownfield sites, on which so much new building is situated. In 2011, there were 63,750ha of brownfield land in England, up 2.6% from 2010. An estimated 51% of this is derelict and the remainder, is in use with potential for redevelopment (NSET:2010). Footprint replacement, however, is more than just simply replacement. Just as countryside and sedum mats do not deliver biodiversity, a sedum mat does not produce ecotopia. The brown roof, which mimics the brownfield site is the material ecotopia. It is designed to *enrich* the urban environment, not simply to replace it. The greenroof network, developers and city planners come together on brownfield sites which are considered by all in different ways: waste versus potential versus ecotopia. As both Reno (2008) and Edensor (2005b) suggest, the making and defining of waste takes power and authority. The redefinition and refiguring of waste into new objects of value takes just as much work (ibid:105). The rise in value of brownfield sites in London have pushed the reintegration of waste land into redevelopment. The greenroof provides an alternative site, a boundary object (Star and Griesemer:1989) on which to agree.

The greenroof network may have compromised over the single species sedum mat in order to kick-start the greenroof industry but they simultaneously developed the brown (rubble/biodiverse) roof. Brown roofs "are essentially extensive green roofing systems that seek to replicate the original ecological footprint prior to development" (Gedge 2003a:4). Ideally, they use substrate formed from the aggregate material of the original site. This ensures "that local characteristics are replicated as near as possible on the final roof as was existent on the ground prior to development" (ibid;

Gedge:2002). Not only is this using an otherwise discarded material, but it deliberately recreates the impoverished conditions of brownfield sites and by extension 'native' British grassland habitat. Nativeness becomes implicated as: "an invaluable national resource for economic, environmental and scientific enterprise" (Kennedy 2010:47). By physically mimicking the soil, brown roofs attract the kind of flora and fauna commonly associated with brownfield sites. This also explains the name brown roof as the aggregates are often brown in colour.

The first brown roof in London was built on Laban Dance Centre in 2002. It is a rubble roof with crushed concrete sourced from the original site. There are now approximately 100 species of flower on the roof. Dusty, who designed and built it, personally collected wildflower seeds from the site prior to the build. Dusty has been constantly observing and photographing the roof for 12 years and the zoologist, Dr Gyongyver Kadas (Velazquez:2004; Kadas:2011) has been monitoring the invertebrate life for a similar length of time. The Laban roof has a special place in Dusty's heart because it was his first and because he put so much effort into it (pers. comm.).

Nigel Dunnet and Noël Kingsbury describe the way that greenroofers have taken inspiration from their local "reference habitats" (Dunnet and Kingsbury 2008:175). This mimesis is based upon the key productive qualities of substrate which link to the local landscape conditions.

> You want green roofs to mimic the natural landscape. Near rivers, you could have a dry riverbed habitat. In Durham they could have magnesium limestone grass; in Alpine climates you have dry meadow flowers. The more diverse the species, the better (Gedge quoted in Lee 2009:1).

The similar taxonomic characteristics of grassland, brownfield and greenroofs are not the flora or fauna, but held within the substrate. A study by Kadas (2004) quoted in *The Technical Report* suggests: "[g]ood wasteland habitats are well drained and low in nutrients; two important characteristics of extensive green roofs" (GLA 2008:23). (see also Bamfield:2005; Gedge and Firth:2004). This identifies, not the species of plant, but the physical material as the important form to be mimicked. The replication of material substrate leads to a specific biodiversity that is dynamic and similar enough to brownfield sites to be generally characterised as identical, although, between ecologists there is still quite a variation of opinion. Respondents describe how brownfield sites are similar to grassland and light sandy soils. Gedge designed the Barclay's Bank roof in Canary Wharf, laid in 2005 as:

> three mosaic habitats – sedum mat to give instant green cover which will eventually turn to grassland, shingle areas to provide bare areas for xeric invertebrates and calcareous grassland mix to provide structured vegetation for invertebrates (Gedge:2013a).

The Barclays Bank roof helped to establish the brown roof as a possible mainstream roofing form. "It was a compromise but working with big business help raise the issue. Barclays was a coup and to be fair to them they spent a lot of money on that roof" (pers. comm.). It is the "only true example of a green roof designed for biodiversity in the Isle of Dogs" (Gedge:2013a).[8]

Green and brown roofs are seen as an opportunistic, authentic nature and the mimesis designed into them is underpinned with the idea that they can develop as opportunistically and open-endedly as the sites they mimic (Lorimer:2008). Ecological succession, "the process by which species successively accumulate and eventually also replace each other when the ecosystem in its entirety is evolving toward a climax state", is dependent on the physical conditions set up by the substrate but is also achieved through chance (Würtz and Annilá 2010:70). Substrate type and depth affect the ecology of the roof. If the substrate is over 10cm, it compacts, tending to produce grassland ecology or, if less than 10cm, the substrate loosens, allowing annual plants to move in (Thüring:2011).

Pioneer species which arrive first tend to predominate (Gilbert 1989:83). Plants known as opportunists e.g. rosebay willowherb (*Epilobium angustifolium*) also predominate and their spread is associated with other species such as moths and butterflies which in turn attract predators and other species, creating circular, dynamic and ever increasingly complex ecosystems. Plants are expected to die out, others to self-seed and still others to colonise as one respondent described it, a "living process where every year is different". Strategies of encouraging plants to colonise and having a "lets watch and see" approach, demonstrate a confidence in nature to take over. Success is indicated and measured by the presence of target species like bats, stag beetles and redstarts (pers. comm.; Wynne Rees:2010).

One British roof which has achieved a climax grassland is the Horniman Museum Extension roof:

> "Nicholson (2004) surveyed the vegetation ten years after establishment and found that the roof had developed into a species-rich neutral grassland supporting a number of plants notable to London" (Grant 2006:3).

[8]Calling a brownroof a greenroof is common. This is discussed fully in chapter six.

Few seldom end up that way. Gary Grant believes direct mimesis cannot be achieved easily:

> I think there are very few if any greenroofs which mimic grassland habitats. Modern greenroofs are a collection of drought tolerant plants rather than a natural association or an analogue of a natural association (interview:2011).

Additionally, he suggests, the problem with grasslands, at least in contemporary Britain, is that they are maintained by grazing and mowing. So greenroofs "are more likely to mimic stressed pioneer communities found on skeletal soils or mountain tops" (ibid). Others suggest that because a rooftop is a "fundamentally different environment than the ground" that the wholesale transference of ground planting is not necessarily appropriate (Butler et al. 2012:1).

Active and Agentive Nature

Nowhere are the agentive capabilities of plants more evident than brownfield sites. These sites are: "abandoned by people and reclaimed by nature; some of London's most valuable and dynamic natural open space" (Chipchase and Firth 2003:3).

Phyto-material environments are made, shaped and decayed by a combination of ecological and human agencies, but underpinned by the agentive capacities of plants which thrive in relative isolation. Plants and animals intersect with and travel between the other areas of the city and countryside along, but also across, ecological corridors and habitats (Edensor:2005b) creating what Ingold calls a 'meshwork of habitation' (2007:103). Plants and animals do not make distinctions between sites, but use affordances. Butterflies, for example, have been spotted on greenroofs 20 floors high (Johnston and Newton:1992). Only humans make the distinction between brownfield and brown roof.

In *The Aesthetics of Decay*, Dylan Trigg describes how the industrial ruin "subverts our everyday encounter with space and place" (2006:5). Edensor (2005b) like others (Garrett:2013; Trigg:2006) describe how the non-human agencies produce this place and space: dangerous; exciting; disgusting; vibrant; dark; dank; isolated; rotting; active; alive with multiple agencies. The senses are central for engagement with place and space. Following Heidegger, Trigg suggests: "[b]eing in place means knowing the limits of that place" (2006:5). Places are not 'natural' but learned (Naipaul:1987;

Tilley 2006:64). One person's dank, dark, illegal, no-go area can be interpreted as another's urban fantasy playground (Trigg:2006; Garrett:2014).

Processes of decay are central to Hundertwasser's work. Edensor (2005a), like Hundertwasser, regards these as creative. Buildings require work because they are in constant contact with agentive non-human agencies. Plants and animals are afforded colonisation and ecological niches and this, in turn, increases the rate and amount of decay. If not continually maintained, they rot and crumble as the plants, moulds, fungi, with their invasive roots thrive, aided by the weather. Buildings are constantly transforming. Trigg calls this 'creative destruction' (2006).[9] Ben Campkin, using Wolkowitz' notion of "postmodern/poststructural dirt … purified through abstraction" suggests that dirt is productive of a cityscape which requires regeneration (2013:15). Dirt here, is not "matter out of place" as Mary Douglas (1966) suggests, but is "fundamental to the processes of capitalist urbanization" by creating an aesthetic of decay (Campkin 2013:128).

The kinds of phyto-materiality employed on buildings have to be carefully managed because they remain full of agentive capabilities like Hundertwasser's 'tree-tenants'. Tree-tenants populate the roofs and balconies of his buildings as the human residents do, with all the rights associated with this act of inhabitation (Hundertwasser:1983). Residents become implicated within his project of maintenance and protection, initialising a personal dynamic between the human and non-human inhabitants. Recent plans (Kendall:2013b) for the Bosco-Verticale in Milan, designed by the architects of the Boeri Studio incorporate trees into the apartment balconies "an area equal to 10,000sqm of forest" (Kendall:2013a).

Placing plants and roofs together creates a juxtaposition of things not usually associated with each other (at least until recently in Britain). Greenroofers, like Hundertwasser, employ Foucault's (2001 [1966]) notion of 'similitude' in order to disrupt the conventions of social order. This results in a different kind of reordering, over time; 'resemblance' which results in the way in which things should go together in culturally, normalised and recognised ways (ibid). By showing that in Switzerland and Germany greenroofing is normal practice, with over 80 million m^2 of greenroofs, compared with only 1 million m^2 throughout the UK (Richardson:2001), greenroofers seek to reassure a wide array of professionals. The greenroof domesticates the wild, uncontrolled nature of the brownfield site, making it amenable to the processes of late capitalism.

[9] Which is how Castree (2010b:1738) describes capital accumulation following Harvey (2005:22) who uses it to describe neoliberalism. See also: Ong (2007) and Barnett (2009).

Space and Dwelling

Michel De Certeau differentiates between place as geographical and space as a field of relations: "[s]pace is no longer a category of fixed and given ontological attributes, but a becoming, an emerging property of social relationships" (1984:140). Jiménez (2003:140) agrees, in his critique of the Durkheimein social and territorial construction of space. Place has historically been an important dimension of sociality. The siting of buildings in relation to each other and to environmental features such as churches, mosques and other holy buildings which are often located on high ground or hills. The roof, in association with the sky offers a symbolic and sacred place and space.

Hundertwasser claims that greenroofs are "more than ecological. It is a religious act to have soil on your roof and trees growing on top of you: the act reconciles you with nature – a very ancient wisdom (Hundertwasser quoted in Dunnett et al.:2011). The inside of religious buildings often feature murals of the night sky, visions of the pre-fall or of heaven which is often conceived of as a garden. Eden's two meanings (taken from Ugaritic) are of a"place irrigated and blessed by water" and of "enjoyment and enlightenment" (Stein 1990:43). Like the garden roof of the Church of the LDS in Salt Lake City and the Stave churches of Norway, with their sod roofs, the Ishmaili Centre, built in 1985 in Kensington, London has a secluded and quiet roof garden over the mosque and cultural centre. The garden of heaven literally extends over these buildings.

> A bridge built across a river 'assembles' the banks and the countries lying on both sides of the river; … A bridge is a thing not only by its 'assembling' of the foursome, but also by its assembling of the places. A bridge throws a variety of places into certain distances in respect to itself, and thus they become places. Such an 'assembling' of places actually is breaking into the space or spacing-in…of space" (Heidegger in Vycinas, 1961:16).

Heidegger's bridge, by reordering the elements in the landscape reorders the relationships between elements (1993:361). Like the bridge or the Black Forest farmhouse the greenroof assembles the elements of dwelling, not just occupying but residing: "inhabitation, cohabitation and the practices of habitation … an ongoing flow" (Grigson 2007:21). The emphasis here is on process and learning to dwell, something Buchli also insists on (1999a; 2013). Like Heidegger's country farmhouse, the Romantic, rural form of the greenroof becomes reinvented into the contemporary form and put to work, governing the urban environment.

Unsettlement and Normativity

The Hunderwasser-Haus in Vienna, with its colourful façade was built in 1986 and consists of 52 social housing apartments. It is one example of his work used to illustrate talks, seminars and training days.[10] Kraftl describes the Hunderwasser-Haus as "comforting and unsettling" (Kraftl 2006:219). Comforting because of the building's smooth and rounded lines but unsettling because of a reinvigorated and strongly agentive nature. It is this creative unsettling of energies which provides "arrays of utopian spacing" for Kraftl (ibid:219). The house provides the room to create and materialise utopia. However, because the building is aesthetically so different from its neighbours it has become a tourist attraction, the residents are at pains to convince Kraftl that living there is 'normal'. They fill their houses with Ikea furniture just like everyone else, he is told.

For Kraftl then, unsettlement of the normal and everyday is necessary to create the conditions for utopia. However, this is not apparent for the residents; quite the opposite, as they normalize and domesticate the building and their life within it. This illustrates "the pervasive dichotomy between the everyday/immanent and the utopian/transcendental" at the heart of unsettlement as a process (Gardiner 2006:4). It is not possible to maintain unsettlement permanently. As Foucault argues, architecture's function is "to penetrate, to stimulate, to regulate, and to render almost automatic all the mechanisms of society" (Foucault 1991:242). When change and unsettlement become incorporated into everyday life, they eventually become domesticated, settling into the kind of quotidian hum-drum routine which de Certeau (1984) and Douglas (1991) describe, whether it is the harmonious, utopian dwelling Heidegger seeks, or not. Hundertwasser's utopian quotidian relies on an agentive nature and the ongoing relationships with it.

Dewey Court

Dewey Court is a late 1970s social housing complex controlled and maintained by LBZ. It is comprised of three sides of dwellings which are all separated from each other and have different postcodes and entrances. They share a small internal garden with trees. Flats on three stories are accessed by lifts and the retired resident's one bedroomed units are on the top-floor section with a covered walkway for access.

[10] Occasionally the Hotel Rogner in Bad Blumau or the Ronald McDonald house in Essen are also used.

In 2008, the roof was tiled with non-standard Redland Stonewold II concrete tiles because of its barrel shape. However, an inspection report (Feb:2009) declared these tiles 'inappropriate' as they are designed to work at a minimum pitch of 17.5° and the roof slope was less than this in places. This caused the roof to leak. Tom indicates that the roof was greened "because it turned out to be cheaper" and describes the problem:

> There was a mess-up with the tiles. When they first installed it they, whoever it was did the build, cut corners and the spacing on the tiles was - didn't have sufficient overlap, so they had to re-tile – and non-standard tiles – and also rip off all the tiles – so it worked out cheaper in the end to put a greenroof.

It is widely recognised inside LBZ that fuel poverty is linked to health issues and social housing tenants are often vulnerable people who sometimes require more energy (Marmot:2010). This is higher in the social housing sector because of less efficient housing stock (Jenkins:2010). Much of the work of the team has been to couple energy, sustainability and health to the benefit of social housing tenants (DECC:2010). The LBZ business case argued that it would benefit elderly residents by keeping them healthy and comfortable, save the council money in heating and provide an alternative habitat for wildlife in a busy area of London. Re-roofing cost approximately £63,500 and was bundled with redecoration, repairs and cavity wall insulation,[11] in order to save on scaffolding erection costs. The thermal gain for the building was 'significant' and expressed in potential financial savings:

> "[t]he introduction of a 600m^2 green roof to a site in London improved insulation to such an extent where modelling showed a £3000 annual saving in fuel costs (at today's prices)" (Frank: email comm.).

There is no indication however, that this has been realised.[12]

Mrs B lives under the Dewey Court roof.[13] In her mid 80s, she is lively, cheerful, and entertaining. She was born in Italy and lived most of her life in London. Now

[11] Which, in the end, did not take place.

[12] And when I suggested I carry out this research, it was denied. The actual figures were irrelevant because the modelling was sufficient for policy recommendation. They feared possible detrimental results.

[13] Before giving her a pseudonym, she was affectionately Mrs B and her neighbour was Mrs M. It stuck.

widowed and retired, she is active as the tenant representative for the block. She has a wide social network and many local friends. Her family visit when they can and she has numerous photographs of her late husband adorning the cosy flat. The roof was leaking badly for about five years and that she and her neighbours had to place buckets and saucepans under the drips. Mrs B does not know much about the physical structure of her building (whether it is insulated, or why no one is allowed on the roof). "I leave all that to Phil", the resident scheme manager who oversees the day-to-day running of the building and "keeps an eye" on the older residents (interview:2011). However, she does have a deep concern for the building, the way it looks and functions.[14]

Mrs B took part in a local university energy trial and had a meter placed in the flat for four weeks. Does she think the greenroof makes a difference? Not really. The effects of the roof are difficult to evaluate mainly because the heating comes from a central boiler over which she has no control. She can regulate the temperature as she wishes with a thermostat and even in summer the heating is on. She is, however, grateful that the roof does not leak any more, but can not possibly say what difference the greening has had. She likes it, though. It is special and she is proud of it.

Too much Nature?

In 2010, a 3cm thick sedum/grassland Green-Grow roof was laid over insulation and a drip irrigation system. As no-one was sure which sedum would thrive in this locale or conditions, the sedum blanket was composed of 13 species including *Sedum montanum* 'orientale', *rupestro*, *pulchellum*, *acre*, *sexangulare*, *ewersie*, *verticillatam* two subspecies each of *Sedum album*, kamtschaticum and spurium.

Hundertwasser's chief concern is that buildings with agentive plants enable new relationships with nature. Mrs B. and her neighbours developed a relationship with the wildlife on the Dudley Court roof, but it was not the kind they envisioned. The most immediate concern is snails. Four months after the greenroof is laid the snails have "invaded" (pers. comm.). By the time Mrs B shows me, it is one year later and the snails are not so numerous (photograph 11). However, there are still quite a substantial number and they cover the gutters and migrate along the handrails onto the warm front walls of the flats. They attract "quite an army of birds going on the roof. They're here first thing in the morning … having a bit of breakfast" but she does not

[14]She complains about a leak from the roof and we go down to street level to inspect about a tablespoon of water on the pavement. It represents her keen eye for monitoring her building.

mind as "there's nothing nicer" than the bird song. But the snails are a problem. The birds pick them off the ceiling and walls of the walkway and drop the shells on the ground outside the front doors of the elderly residents. They crunch underfoot as we walk. Many of these residents already feel unsteady on their feet and walking on shells makes them feel even more unsteady.

This infestation has been the subject of gossip among residents in other parts of the housing estate and has put at least several residents who live on the other side of the quadrangle off the idea of having a greenroof. "My number doesn't have a greenroof, *nor want one* … and they now have snails on their balconies to which the magpies dive to get them". Another resident has noticed too: "snails come out of the greenery onto the balcony ceiling. They are lunch for magpies". There is some disagreement over whether the birds are magpies, pigeons or another species. It is probably a mix with some residents encountering one kind of bird or another. It is Frank's opinion (as one of the project managers) that the snail infestation originated in the growing beds. Consultations with other greenroofers leads to the same conclusion. This is not common, but happens occasionally. From visual identification the snails appear to be *Cepaea hortensis*, or a similar species. However, when the recommendation of a one-off application of organic bait is made, Frank indicates that the use of poison is unacceptable for two reasons: the possibility of killing birds and contamination of water run-off. Frank is concerned with people and ecology on a large, societal scale and freshening the run-off is one of the healing aspects argued for the urban environment. None of the team is concerned that the residents have difficulty walking outside their own front doors.

The idea of nature as highly agentive and the ability to capture and control this is dependant on the plants being alive so as to act as proxy, exhibiting agency on our behalf, cleaning and healing the world from the harmful effects of climate change. However, for others who see different capacities, do so from their own vantage points and may not agree that plants in the urban environment are not harmful. There are consequences to constructing a roof-top ecotopia. Sometimes this non-human life does not stay there but overflows into areas which are not acceptable to respondents. The discrepancy between what greenroofer ecologists desire: increased insect populations is not always what residents want. Classificatory practices, keeping nature in its place becomes out of place here. In another borough, LBQ, a plan for a green wall was stymied because of resident complaints that it would bring an increased number of unwanted insects into their flats. This is a repeated complaint when an increased level of city flora is proposed, and as a study in Basel, Switzerland, found 172 species

of beetle and 60 species of spider on 11 roofs (Brenneisen in Grant:2006), this is not an unreasonable concern.

Some residents under the proposed greenroof at Norcross Close (chapter eight) talk about the notion that nature actively sickens. Several people were concerned about an increase in the pollen count for allergy sufferers. One resident was also concerned about increased asthma attacks. The housing block is surrounded by a substantial number of trees and many residents had vibrant window boxes as well as gardens both front and back, but the possible increase in plants was worrying for them. These concerns may be largely unfounded according to research (Currie and Bass:2008). Lighter, wind borne pollen, moulds and dust cause allergies and many varieties of sedum have heavy pollen which is carried by insects. In addition, the low growing and spreading plants cover the substrate and reduce dust, particles and airborne mould spores. However, after more than a century of cleansing and sanitising the city (Campkin:2013) the perceived change of direction is disconcerting for residents. Their concerns are still legitimate.

As the rejection of the LBQ green wall demonstrates, many residents in cities where nature is perceived to be lacking or carefully controlled *like it that way*. Too much nature becomes interpreted as intrusive, a nuisance, unhealthy or sickening. These attitudes are often dismissed by ecologists, council officers (LBZ and LBQ) and greenroofers who characterise urban centres as devoid of wildlife. They believe that education is the key to changing these attitudes and they spend a lot of time and effort running information sessions, instructional courses and maintaining websites (many pers. comm.). At a recent greenroof training day (January 2013), it was suggested that a perfectly 'normal' thing to do is to build a mouse house near your home. What was clear was the assumption that we should want one and be comfortable about this. What was unclear was how many of the audience were thinking that the last thing they wanted to do was encourage animals identified culturally as pests or vermin and known to be destructive, near their homes.

Nature in the Wrong Place?

The moral orders perceivable in these examples of appropriateness show how communities of practice are often opposed. Some flora and fauna have a higher worth than others. Synanthropic[15] species like foxes and robins which associate

[15]From the Greek *syn* meaning "together with" and *anthro*, "man"

with humans do not and are not expected to become domesticated or companion species. They remain "robust, self-maintaining and visually acceptable" (Gilbert 1989:6). More generally, plants which get in the way of human endeavour are subject to malicious names and characteristics: they are weeds (Mabey:2010): "the botanical equivalent of dirt … plants out of place" (Cresswell 1997:335). Emily Martin's (1991) now seminal demonstration of how stereotypical gender roles assigned to aspects of reproductive organs in biology texts affects perception of them is in many ways mirrored in the garden with metaphors of violence.

Unwanted or out of place plants (and animals) have been described as: immigrants, colonisers and alien species. They can be aggressive and invasive, introduced, casual, parasitic, opportunistic and pioneering, 'over' grown, scruffy and untidy, standing in contrast to native plants which are displaced, outcompeted or forced to extinction. These metaphors of 'invasion ecology' have been traced to Charles Elton who served in WWII, exterminating crop-eating pests (Chew and Hamilton:2010). Mabey declares: "[w]eeds are not just plants in the wrong place, but plants which have slipped into the wrong culture" (2010:11). Whole ecological systems such as brownfield sites are 'waste' land and materials such as concrete, tarmac or fibre glass are "alien artificial materials" (Gibson 1977:1). Animals given a number of invectives include enemies (cockroaches), scavengers (foxes), pests (mice), feral (cats) and vermin (rats). Vermin are variously described as dirty, diseased, destructive, dangerous and above all are detested, and along with parasites they have been historically used to link housing and health in the attempt to regulate the urban environment (Campkin:2013).

Beetles, "the little things that run the world", are loved by environmentalists but often given a bad reputation (Wilson 1987:344). Some urban species such as foxes and feral cats are acceptable to people but not others. Urban pigeons, like the ones feeding on the snails on Mrs B's walkway, have shifted in reputation and are now often believed to be dirty and disease-ridden (Jerolmack:2008). Self-builders like Jon Broome, who put a greenroof on his house over 20 years ago, actively attract this kind of wildlife. He reports "that a fox regularly lies up on the roof and wasps have nested in the turfed areas. Apple trees overhang the roof, and fallen apples on the flat sections attract blackbirds and other birds" (English Nature 2003:28). As an architect specialising in sustainable building, Jon is proud of the wildlife his roof attracts, however, others like the residents of Dewey Court are not.

So far, the chapter has argued that Hundertwasser's FR philosophy has been influential within the greenroof network and the primary reason for this is the recognition of an agentive relationship with nature. The last section attends to the conditions

of ecotopia which are assembled through greenroofs. More than footprint replacement and an agentive relationship between plants and people, green and brown roofs are intended to improve the urban environment for flora and fauna and for people. Contained within these relationships are the imperatives to heal, to assemble nativeness and to ultimately achieve wildness as conditions of ecotopia. As Taussig, following Mary Douglas and Lévi-Strauss, argues, "culture externalizes its social categories onto nature, and then turns to nature in order to validate its social norms as natural" (1980:33).

Healing Nature Healing People

Hundertwasser's concern with the relationship between buildings, nature and people is underpinned by the notion that because nature is agentive, it has the ability to heal. The chemical nature of plants, for example, have formed the basis of medicinal remedies from before the time of Galen (Katz and Kirby:1991). A growing body of evidence suggests that visual and physical contact with natural greenery provides a range of benefits to people (White and Gatersleben:2011), including a reduction in heart rate and blood-pressure (Dinsdale et al.:2006; Tzoulas et al.:2007) aiding general well-being. There are long term benefits from cleaner air (Currie and Bass:2008; Rowe:2010) attributed to greenroofs. Safety within the city has been linked to green spaces (Moore et al.:2013). Roe and Aspinall's (2011) research claims that landscape and forests provide affordances for emotionally traumatised boys to achieve 'instoration' or healing.

Cultural links to healing aspects of nature have become so naturalised in the UK (van den Bergh:2007; van den Berg et l.:2007) that the popular view resonates with Gibson's claim that: "[p]eople do not need instruction on how to enjoy nature" (1996:8). This harkens back through historical writing on the Romantic (Katz and Kirby:1991) to the contemporary ecological writing. Richard Mabey (2010; 2005) and popular gardener Monty Don (2004) both view nature as psychologically restorative, while the ecological journalist George Monbiot (2013) advocates wilding as a cultural as well as ecological strategy.

Greenroofers draw on evidence from psychological research on green spaces to fill the gaps in research on greenroofs.[16] Given the huge anthropological literature on

[16]This was one of the things people asked me to do and were disappointed when I could/would not.

cross cultural variation in the way living and non-living beings are categorised (Descola:2013) and the differences in the entanglements between nature and culture the world over (MacCormack and Strathern:1980) this healing relationship seems difficult to support from an anthropological point of view. Nature is specifically modern and Western with many societies shown to lack such a category. Non-Western societies have differently ordered ontological borders or categories where plants and animals, places or landscapes entwine with human-ness (Descola and Palsson:1996).

What constitutes nature and where its appropriate location is also change through time (Casey:2009; Daniels:1993; Duncan:1995). The links between open spaces and health were historically and materially established through the Parks Movement in England, Europe and the US by the 1830s. The movement relied on an intimate, beneficial and improving relationship between people and access to nature. By contrast, the city was polluting and sickening. Epidemics such as cholera, smallpox, tuberculous and typhoid were common and coal pollution was extensive. After the Germ Theory of Disease in the 1860s, parks became increasingly linked with good health and sanitation and by the 1880s most towns in Britain had a park. Gifted by philanthropists and bought by public subscription they were "places of betterment", improving, not just of health but of moral character (Jordan 1994:85). Aimed initially at the lower classes, they brought people of all spheres into contact with one another, changing the social life of towns and cities as everyone gained access to these open spaces.

There may be no *a priori*, universal, stationary restorative nature, in the full philosophical sense, but this is so culturally embedded that nature, for respondents, *is* a healing force and actions are predicated upon this relationship. For example, Ulrich's (1984) suggestion that access to green vegetation could shorten hospital convalescence time has circulated widely through greenroof and policy networks and documents. A roof on the Kanton Hospital in Basel was redesigned 20 years ago by vegetating it, because it was felt that patients in intensive care would benefit from looking out onto green rather than a grey landscape. A number of American hospitals have subsequently been redesigned to bring these benefits to patients, and they argue that they have been rewarded with greater patient 'through-put'. Great Ormond Street Children's Hospital completed a roof garden in 2012: "intended as an antidote to the everyday hospital environment and is a way of improving the working experience of staff" (Great Ormond Street Hospital:2008). A few community hospitals in the UK are now being designed with a greater consideration of green-space provision, and the good-practice work on hospital design being developed by Commission for Architecture

and the Built Environment (CABE) is likely to further this.

More substantial research by English Nature supports a direct link between health, well being and access to nature, recommending that everyone should have some form of contact with green space more than 300 meters from home (Barker:1997; English Nature:2003). The MEA has established this link between ecosystems with health (Percu and Lubchenco:2005; Watson and Zakri:2005). The London Plan (2008) outlines the established research links between wellbeing and psychological benefit and access to green spaces. Lord Richard Rogers, Chief Advisor of Architecture to the Mayor of London says:

> Having direct access to open space makes a substantial difference to the quality of everyday life. It provides a sense of visual and physical relief, allowing people to expand their living experience and enjoy the benefits of city living (Rogers:2004).

Since Victorian times, London borough authorities have taken their statutory obligations to provide and maintain open or external space very seriously. LBZ planning advises "residents further than 1km away from a metropolitan or borough Site of Nature Conservation Importance (SNCI) are considered to have poor access to the natural environment" (LBZ Planning Guidance, Amenity:71). Anne Power (n.d.) among others, links the provision of adequate open space to social sustainability.

Mill Lane Community Centre

Mill Lane Community Centre[17] is part of a 1970s council-built complex which is architecturally renowned in London as one of the major modernist housing projects of its era. It was designed by the local authority's in-house architect. Ecotopia was expressed through the architectural form of the housing units, set in acres of parkland and many residents buy their properties on the understanding that it remains this way. The community centre is situated away from homes in a quiet corner. It is surrounded by trees with a hard court games pitch on one side. It is a one storey concrete building with three roof levels (82m^2, 38m^2 and 135m^2), accessible by a staircase on either side of the building. The narrow areas, lining the front of the building, are normally inaccessible (photograph 10). The roof was initially designed to support a garden area (email comm.:2009) but paved with flagstones instead. By 2008, the

[17] Hereafter, Mill Lane.

building is in disrepair and identified for refurbishment. There is a vibrant and active resident's committee, and they earmark this building for dedication to the estate's African community. This greenroof project involves almost all of the LBZ sustainability officers but chiefly Tom, Frank and Kofi. The project is managed to completion by summer 2011, although Tom and Kofi have left LBZ by then.

The low white walls have a little light graffiti on the inside although the outside remains untouched. This is seen as evidence of neglect and mis-use. The staircase to the roof has been locked up, for this reason, although it is quite easy to access through a hole in the fence. I am informed that the roof is being used by local drug users. Someone mentions that needles were found, and later, after the roof is completed, I hear it was joint-ends. Although several council officers and the building manager repeat this, they can not tell me how they know, I personally see no evidence of it and can not find the eye-witness. The identification of a 'real' social other is not important, the idea of a 'mythic' other is provocation enough and is mobilized into the narrative of a responsible borough council who have already identified the correct course of action to heal the building.

The utopian power contained within the modernist building has been seen to fail by attracting 'the wrong people' and now needs to be restored and regenerated by phyto-materiality. The suggestion of 'drugs' is enough to taint the building, associating it with sickness, deviancy and allowing it to be recognised as in need of regeneration. The community centre, which should be the hub of sociality is identified as a 'sick building'; contaminated with non-human mould and vermin as well as the human contamination of drugs, graffiti and physical damage. This is not a Hundertwasserian vision of an active and agentive process of decay. Decay can not be allowed to spread and infect the whole of Mill Lane, turning it into a 'sink estate'. The flats on Mill Lane estate are too valuable for that.

The roof is specifically charged with reinvigorating and cleansing. This will revive the whole building and the local residents in line with LBZ policy where: "[g]reen roofs will, though be considered as part of housing regeneration projects" (LBZ Report, Food, Water, Biodiversity and Green Spaces:2008). As Mary Douglas (1966) discusses, dirt is spacial. Its categorisation depends on location, although some things (like vermin and drug-taking) seem to have no appropriate location and other things which qualify as 'dirt' are not necessarily pollutants. By regenerating the building, the link between persons and architecture is made explicit. Improving or regenerating the site does not eliminate the 'problem', rather, it moves it on to another location where it ceases to be visible. Making problems invisible by relocation disentangles

LBZ from responsibility. An attempt to reinvigorate the failed ecotopia was undertaken by Sandra from the LBZ sustainability team who organised a vegetable growing scheme in 2010 at the back of the community centre. This community engagement was used as evidence for the internal LBZ greenroof business case and was cited in documents written to the funding body, the SITA Trust.

'All of a Buzz…'

In addition to rejuvenating the building and residents, the Mill Lane project was required to rejuvenate nature, through providing biodiversity and the project contributes towards targets in LBZ's BAP. The project was managed through Buglife's Living Roofs for Wildlife project. Buglife, The Invertebrate Conservation Trust, is a charity which works to prevent invertebrate extinctions in Britain. They identify brownfield sites as "'surrogate' habitats" and "a last refuge" for wildlife and they recommend and provide funding for brownroofs (Buglife:2013). Buglife partnered with SITA, an environmental non-profit organisation which funds a variety of community projects involving habitat restoration and creation. LBZ funded all re-roofing costs, including scaffolding. SITA supplied the materials, including gravel areas, root barrier, steel angles and plug planting. They also funded the installation of three water sources on the roof, which is a requirement for the guarantee and insurance.

Costs also include extensive monitoring of invertebrate life for three years and the funding supplied by SITA was conditional on this. The researcher, from the UEL greenroof centre, under contract to carry out the study had completed her PhD research into the invertebrate life on several of Dusty's other greenroofs. Dusty Gedge's company was commissioned to lay the roof, due to his involvement as a recognised expert in the field, the company's experience with creating open mosaic habitat and their proposed use of local aggregates.

Revisions to the plans were ongoing and had to comply with the specifications which Buglife had laid out. The funding was strictly aimed at providing the correct substrate for invertebrates and this was carefully planned from the beginning as crushed brick rubble, making the roof brown/rubble/biodiverse. Buglife had also stipulated a minimum greenroof area and the LBZ proposal for vegetable growing was rejected because the roof area only totalled 296m^2. Mid-way through the project, Tom proposes rainwater harvesting and automatic irrigation systems costing an additional £2500. This too was rejected as it was not included in the original agreement with

Buglife. The LBZ officers were unused to this lack of flexibility on projects. Planning permission was also an ongoing struggle. Consultation with the LBZ development and control team indicated that the greening: "will constitute 'development' in planning terms and is not exempt from the need for planning permission under the General Permitted Development Order" (email comm.:2011). Later, the reason given was the proximity to the estate which is a listed building (pers. comm.).

Frank sends an email round to announce a planting session and on a sunny morning in June, six of us arrive from LBZ. The rubble on the lower stretch of roof has been laid already and Dusty is raking it into mounds hills, troughs and sharp ridges for different kinds of plants (photograph 9). These are all grassland habitat plants aimed at encouraging insects and we plant these as plug plants[18] in clumps: seven in a circle and one in middle. During this, we get to know one another. Afterwards everyone goes back to the office and I help Frank and Dusty rake the upper roof. The Buglife project officer arrives in the afternoon and more planting out is done the following day with the help of Dusty's son, his son's friend and the UEL researcher who monitors invertebrate life. This kind of informal help with raking and planting is common on Dusty's greenroofs. There was very little resident interest in the project, despite advertising. The building manager was present at the start but when jobs are being assigned, she disappears quietly.

Assembling Nativeness

Sitting in the LBZ office one afternoon, we have a discussion about nativeness. On one side of the debate is Tom who believes that as plant and animal life move in response to climatic changes, the native biodiversity of Britain will change because the non-native plants will move north. He specifically describes how Mediterranean plants have transplanted well in Britain. He cites the proliferation of wineries in the UK in support. The Black redstart is also an example of this, extending its range northwards. On the other side is Frank, who argues that we should be supporting native British wildlife to build up resilient ecosystems and biodiversity and that non-native plants should be actively excluded from greenroofs. The notion is that native species are best suited or adapted to the local conditions. They provide affordances for local invertebrates, animals and birds and that once established, they will out-compete

[18] I planted oxeye daisy (Leucanthemum vulgare), which is a white perennial. It grows 30-45 cm and has white flowers from May to October in sunny sites. It is a good nectar plant attracting butterflies and bees.

most weeds and incoming (alien) plant species.

Most greenroofers I meet support Frank's position, citing the idea of grassland as the ideal native habitat and as the 'original' British ecology, as discussed previously. Native and alien, as a way of describing flora and fauna was coined by Hewett Cottrel Watson in the mid 19th century. However, the problems of defining what is native and when it begins, or what historical period it may be located in[19] are huge, as Kendle and Rose (2000) discuss. They reveal:

> definitions are not founded on hard science, as often implied but reflects a set of value judgements about the timescales of environmental change and forms of human impact regarded as acceptable with the landscape (2000:19).

They go on to argue that most consider native plants to be "superior" to other plants because of their lack of invasiveness, their biodiversity benefits and "their contribution to [a] local sense of place" (ibid:19).

Native plants are argued to grow better and be hardier than non-natives (Rose and Kendle:2000). Gibson suggests: "native species display a wider ecological amplitude in the disturbed conditions of towns than they do in the closed vegetation of the surrounding countryside" (1998:13). They are argued to be more tolerant of local conditions and more supportive of local fauna and fauna:

> 'When you put things that are non-native into areas, it sometimes has detrimental effects. It doesn't support the insects or birds or bees of that environment,' he said, adding that the local dudleyas would have a better chance to develop as an ecosystem on rooftops and be an effective green roof. (McDonald quoted in LMU/LA:2013).

Butler et al.'s survey of greenroof papers on native plants found three assumptions: that natives were better adapted to conditions, they were more aesthetically pleasing and that they provide greater environmental benefit (2012). However, within greenroof networks nativeness is rarely defined.

> If a design is made according to the needs of the plants and animals of the region, it will attract a wide range of biodiversity to the roof (Brenneisen quoted in Benjamin et al. 2013:74).

[19] Post Neolithic, post Roman, post medieval, or post-1500 (neophyte) in opposition to pre-1500 (archaeophyte)?

John Little likes the balance between native and non-native plants (interview:2011). Non-natives are showy, he explains, and he uses them to attract people. Then he disperses natives between them. Instead of laying a flat layer of substrate he varies the depth and this varies the types of plants that take hold, building a biodiverse aesthetic.

Simultaneously, many non-native plants are argued to outcompete natives (Rose and Kendle:2000; Gilbert & Anderson:1998). Most definitions suggest: "[a] non-native species (NNS) is a species that has been introduced into the country by human intervention (either deliberately or accidentally)" (NNSS:2013). There are two types of introductions. 'Naturalised' plants and animals are considered non-harmful non-natives and are tolerated by botanists, ecologists and gardeners. Many of these are extremely valuable in Britain (Gilbert:1989) with buddleia (*Buddleja*), laburnum (*Laburnum anagyroides*), sycamore (*Platanus occidentalis*) and Swedish whitebeam (*Sorbus intermedia*). Over time these introductions have contributed to the aesthetic and biodiversity of the British landscape. As Tilley suggests, the entanglements of plants and nationalism are strongly felt. "The English choose to recognize something of themselves in the image of this disorderly collection of rambling brightly colored flowers" (2008:245).

'Invasive' plants such as the Spanish bluebell (*Hyacinthoides hispanica)* and animals like the grey squirrel (*Sciurus carolinensis*) are described as disruptive, causing damage or outcompeting native species such as the red squirrel (*Sciurus vulgaris*) or the smaller English bluebell (*Hyacinthoides non-scripta*). The concern is that native species may become extinct through being out competed by the supply of continental or agricultural forms of wildflower (Gilbert and Anderson:1998). In addition, the introduction of genetically modified plants will erode the strength of diversity or an imagined natural naturalness. There is a fear that these foreign, invading plants may homogenise plant-life, causing a reduction in immunity to disease such as Dutch elm disease (Lohr:2013).

Species continually become extinct, repopulate or are reintroduced, such as the recent release of beaver (*Castor fiber*) into Scotland (Moore et a.:2013) and they are no respecter of national or state boundaries (Kendle and Rose:2000), as Tom points out. British natives also go abroad. Bracken (*Pteridium aquilinum*), chickweed (*Stellaria*), knotgrass (Polygonum), stinging nettle (*Urtica dioica*) and bindweed (*Convolvulus arvensis*) are found all over the world (Mabey:2010). One of the mechanisms for the development of biodiversity is the movement into new and novel ecosystems and the changes in affordances this produces. Changing climatic conditions are changing

biodiversity itself.

At Mill Lane the provision of the substrate and plants were identified to physically mimic brownfield site biodiversity. The plants were chosen very precisely for the kinds of insects and wildlife they were intended to attract. These too were described as British native species and many were linked where possible to policy documents on rare or endangered species. Deptford pinks (*Dianthus armeria*) for example, are a Priority Species in the UK BAP, listed as endangered on the Red Data List and protected under Schedule 8 of the Wildlife and Countryside Act, 1981 (The Wildlife Trusts:2013).

Despite Buglife and SITA being very clear on the exact specifications, by the time of planting the plant list had significantly altered. It did maintain the same principles of nativeness expressed through wildflowers for insect attraction, perennial (with a life cycle of more than two years) and grassland-loving plants (See Appendix III for full lists). Complex webs of biodiversity do not magically appear overnight: "[c]olonization takes time, as do the delicate processes involved in creating rich webs of species interdependency" (Hindley:2007). The plants on the Mill Lane roof were chosen to develop this complexity. They attract insects, especially pollinators such as bees, ants who spread seeds and birds which eat insects (English Nature:2003). The Mill Lane plants were expected to preform a job and they did so dramatically, developing the kind of dynamism which was expected of the roof.

When Gedge visited the site shortly after planting, he reported online triumphantly that he had spotted a Black redstart.[20] Identified as rare, endangered and a flagship species, the bird also becomes the measure of success for a greenroof. The roof was doing exactly what it was supposed to do, for as Rosenzweig says: "if you build it they will come" (2003:title).

Wildness

Roy Ellen, describing the relationship between plants and humans as co-evolution, outlines the different epistemological positions anthropologists encounter:

> Despite contemporary scientific deconstruction of the concept of domestication, emphasizing process, fluidity, and soft boundaries, ordinary humans seemingly insist on Cartesian symmetry, forever reinventing the

[20]Reference withheld for anonymity.

> opposition between wild and its other, using the distinction to establish moral hierarchies and relishing all possible metaphorical elaborations (2009:426).

In the 'semantic clusters' which swirl round the terms wild and native my respondents, many of whom are ecologists and knowledgeable botanists, use these terms precisely at times, more loosely at other times and in different conditions and to different audiences. However, they largely agree upon definitions that speak to the degree to which flora, fauna, ecosystems, habitats or landscapes are in contact with humans (Katz and Kirby:1991) despite the inherent contradictions this statement contains.

There is a tension between isolation as a condition of brownfield sites and isolation on greenroofs. This has more to do with the idea of unregulated plant growth than it has with footfall or human contact. In the same way as respondents describe the way an unnatural roof may achieve, a measure of semi-naturalness though being greened, in a surprise move, isolation and lack of human involvement complete the change within the context of long time, ofthe un- or semi- natural into the wild or natural.

The case studies of Bluebell House, Dewey Court and Mill Lane have one thing in common; they both provide the conditions for plant isolation, although it can be argued that they do so to differing degrees. The Dewey Court roof is isolated because the roof is barrel shaped with limited and locked access. There are few who are qualified to step out onto it. The Mill Lane roof is protected by a locked gate, although as mentioned before, this can be bypassed. Isolation requires good construction techniques to provide longevity. Roofs afford isolation for both humans and non-humans. They are not often (although Mill Lane is an exception) designed for people and, to state the obvious, they are often high up, dangerous and inaccessble by the general public and residents. In these circumstances nature becomes 'wild' because the roof affords alienation.

Wildness emerges at the intersection of Western notions of nature and humans: "[c]ontemporary Indians often use the word wilderness as a negative label for land that has not been taken care of by humans for a long time" (Anderson 2005:3). Breaking the intimate connection between people and land results in 'wilderness'.[21] The physical isolation afforded by roofscapes creates the conditions where wildness is possible by alienating flora and fauna from human contact, but not from other flora and fauna. British native wildflowers in turn construct, shape and reflect local

[21]This pre-colonial condition provides a 'standard' for restoration practices in the US (Anderson:2005).

environmental conditions. The constructed nature of the greenroof starts off as technological, configured, human-made but in processes of affording the continuing life of the plants and the associated vertebrates and invertebrates, it becomes wild, or achieves wildness.

A greenroof is not often completely isolated, however. There is a careful balance of isolation and maintenance. In practice, many roofs require ongoing maintenance, which falls into two categories: watering and weeding. Insurance companies often insist on two to three years of quarterly inspections in order to comply with their regulations. Watering, especially in hot summers, is part of this regime of care to ensure the establishment of a roof. It is also often a condition of insurance to install a tap for this purpose. Many respondents talk about greenroofs and plants possessing intentionality. One of the characteristics of a 'good greenroof' is that it should be self sustaining. Occasional maintance enables this but after several years watering is expected to cease and only be undertaken in occasional circumstances.

Weeding is more complex. Plants with strong taproots which could destroy the protective root barrier layers and then the roof structure over time are to be identified as weeds and pulled up without mercy. These "aggressive Jack-of-all-places" and "adaptive generalists" (Mabey:2010) include thistle (*Asteraceae*), willow (*Salix*), Buddleia commonly known as butterfly bush and stringy stonecrop (*Sedum sarmentosum*) which is considered invasive. Yellow rattle (*Rhinanthus minor*) or cockscomb is semi-parasitic, especially to grasses, because it attaches itself to the roots and can severely stunt growth. In the US plants like *Poa compressa,* a native meadow bluegrass species and *Artemesia schmitiana* 'Silver Mound,' which is a variety of sage are invasive. Bamboo (*Bambusa*) anywhere on a roof is a complete disaster because the roots are so strong they will quickly tear though the root barrier and into the fabric of the roof structure (see video Resystemsgroup:2008).

LBZ officers argue that native plants will out-compete most of these invasive and damaging plants, in order to downplay the ongoing maintenance which is expensive. Once their short term contracts with greenroofing companies expires, maintenance falls to the local council and often falls between departments. The sustainability team has informally and occasionally inspected their greenroofs in order to pull up invasive plants. However, with the funding cuts and officer reductions, this team and other maintenance teams are reluctant to take on extra work which may not only stretch their already dwindling budgets but their expertise as well. As of spring 2013, no officers remain in the sustainability team who recognise and eliminate invasive plants. Therefore ongoing greenroofing practice at LBZ is reliant on self-sustaining roofs and

sedum is considered to be the best for this although it does not deliver on biodiversity.

Sedum roofs can, however, be retrofitted for biodiversity making them "managed environments" (ecologist pers. comm.). Dusty has been enhancing the Eversheds roof (chapter six) in the City of London. Despite this kind of maintenance, respondents talk about biodiversity being able to develop in the rarified conditions of isolation. Christine Thüring, an ecologist who studies greenroof phyto-sociology, the way that plants form communities, finds that they become self-regulating meadow ecologies. Christine indicates that on older German roofs, which have grown continuously during 100 years or more, the roofs become self-regulating meadow ecologies: "after about 10-30 years a very stable community will establish - in fact some of the studies suggest - 15 years" (pers. comm.:2011). As she speaks, she starts to call these long established habitats "natural".

Christine characterises the built environment as unnatural, plant-life as natural and human involvement with plants as changing the natural plant into the semi-natural. "The forces of Nature do not distinguish between the urban and natural" (ibid). However, she also talks about the way that biotic forces persistently change the ontological character of the built environment from unnatural to natural: "in inaccessible sites where biotic forces persist, undisturbed, the interconnectedness of life is perceptible" (pers. comm.). "They [greenroofs] evolved with humans, they wouldn't be here if it weren't for humans" but this is "natural colonisation of the urban environment" producing semi-natural greenroofs with natural roofs over time.

Hawthorne Heights: Form Follows Forgetfulness

Hawthorne Heights is a very small social housing block tucked away beside large Georgian houses and was built about 1960. At an LBZ meeting greenroofs were being discussed and it was discovered that one of the participants, from another team, had never seen a greenroof, so a visit to Hawthorne Heights was arranged. It was important for him to see a greenroof and it was expected that he would want to. Tom the team's ex-leader, had not, despite being the project manager, seen it either "I have some photographs of it, but I haven't seen it… I would love to see it" he indicates. He has never had the time, so we all go on a roof visit.

We climb the rickety ladder at the top of the concrete stairwell, each holding the ladder in place for the others. At the top there is a climb through the ceiling onto a platform and this is achieved with no little amount of verve. Yaw, the building manager

climbs up last. Half way up, I take a couple of seconds to wonder how he manages to climb it on his own, but later he assures me that he is "used to it". Scrambling onto the platform is not easy. It is chock full of equipment, discarded bits of wood and things Yaw might need to achieve the smooth running of the building under his care. We dust ourselves off and he unlocks the door. Stepping out into the sunlight and onto the greenroof, it is brown, flat and springy under foot. The view is bewitching and we identify another greenroof and some familiar landmarks. A nearby building houses solar panels which are supposed to track the sun but are broken, so Tom declares them "green washing". Yaw stands by the wall, watching us wander round, delighting at the plants and examining them as we go. He gazes at the crazy 'others' from the council who seem captivated by a few nondescript plants. He does not understand our fascination. Does he come out here much? "No", he says. He has little interest in the plants. The roof is everything Tom and Frank hoped for and they wander round inspecting and identifying the plants which have colonized. The roof has been isolated for five years and Tom is pleased with the results. They got their job right and nature has taken over.

Conclusion

The idea of taking space in the city to produce a wilderness is a bold one. Inspired by Hundertwasser's philosophy, greenroofers provide replacement of an imagined 'original' habitat. However, FR does more than simply replace. It improves. By providing affordances for the development of biodiversity, nativeness and wildness it promotes the development of healthy cities. Flora and fauna do not judge or care whether green or brown roofs are artificially constructed or new, but find affordances and take advantage of them. Nature is particularly active and agentive in this process.

Just as the danger of the industrial ruin, the symbol of the destructive, voracious side of capitalism (Mah:2012), requires control and reintroduction into capitalism through processes of regeneration, so too does the nature contained within it. Rehabilitation of the aesthetic of ruination turns into the shiny floored, open-plan, transparent skyscrapers of London. Just as surely, an attempt to pacify the danger of brownfield nature is concentrated and controlled through repositioning on London's rooftops. Even where isolation is the key to wildness, roofscapes are often highly managed ecosystems. Nature, as an improving, healthful force, meets a lived reality, with its complex moral landscapes of interpretations and knowledges. The ecotopia envisioned is not everyone's idea of ecotopia. In the next chapter, the variety of greenroof

forms and what they enable and afford are considered.

7

Flexible Ecotopias: Classification and Ontology

> The low scrubland of densely packed succulents is in full fall color, a carpet of green fading brilliantly to red and gold. This 2.5-acre oasis, located among a barrens of blacktop roofs that stretches east to Broadway and west to the Hudson River, would be an impressive sight even if it wasn't sitting atop the U.S. Postal Service's 1933 landmark Morgan Processing and Distribution facility in midtown Manhattan (Stutz:2010).

The geographical surprise described in this vision of birds and carpets of green reveal the enchantment of this developing city aesthetic. Plants are found in the country, in a garden, in a park, not on a roof. In *The Order of Things*, Foucault discusses how the:

> "disconcerting effect of the proximity of extremes, or quite simply, with the sudden vicinity of things that have no relation to each other; the mere act of enumeration that heaps them all together has a power of enchantment all its own" (Foucault 1998:xvii).

In processes of classification, social science makes a distinction between the symbolic and the social. The symbolic, conceived as conceptual difference serves to enable

and establish boundaries, separating and re-establishing group membership (Lamont and Molnár:2002). Social and resource exclusions are the manifested result of this boundary work. The 'kind-making' (Hacking:1992) which results from greenroof boundary work is much less exclusionary and preforms more flexibly than these formulations imply. Greenroofers draw different kinds of greenroof together, or separate them according to context and need. They deliberately keep boundaries flexible in order, at least in some circumstances, and for the time being, to manage the practice of greening the built environment. Nowhere is this more evident in the naming and classification of greenroofs.

First this chapter asks, when is a greenroof not a greenroof? The answers to this question reveal the unsettled debates about authority and expertise and speak to a flexible and pragmatic ontology of greenroofing which enables greenroof to be materialised. The chapter goes on to discuss the naming process at LBZ and how this flexibility becomes a problem for council officers and residents. Next, the way greenroofs afford scaling is examined. From garden shed to World Heritage site, from past to present and from local to global, the greenroof alters through context but remains recognisably the same. Lastly, the chapter examines the idea of spacing nature. What is at stake when guardianship of nature is claimed, made authoritative and naturalised? What is developed and strengthened or undermined through classificatory projects?

Q: When is a Greenroof not a Greenroof?

a) when it is on the ground

Greenroofs are intimately linked to Le Corbusier's 'fifth elevation' (2008), the roof. However, what constitutes a roof can sometimes be unclear. The roof of an underground building is not only at ground level, it *is* the ground. This presents a problem. For example, are Jubilee Gardens, located on the roof of Canary Wharf underground station a greenroof? As the tube station building is underground, yes. However, because it is on the ground, and people can walk on it without climbing a building to reach it, technically it is also a park or garden. It can be one, the other, both, but never neither.

Some respondents indicate that it is the physical, spacial and intimate relationship of the greening with the roof which allows them to claim it as a greenroof. One respondent on Twitter said of Jubilee Gardens: "Not [a greenroof]. Otherwise the

grass in Parliament Square is also a green roof :)" (Tweet: JohnH @datainadequate 11/06/2012).[1] For this respondent, Parliament Square is not thought of as a greenroof although it has the same physical relationship to the ground, the roof and the plants as Jubilee Gardens roof/park area. It is not often thought about as a greenroof because the square has been in use for a long time before the car park was built underneath it. It is also included in the *Living Roofs Case Studies* (GLA:2012) guide as a greenroof. Gedge and Firth also claim Jubilee Gardens (2004) among many other underground sites in London as a greenroof (pers. comm.). Gedge was pleased when the Occupy Movement erected tents in Finsbury Square after their eviction from St. Paul's Square in 2011. Finsbury Square has an underground car park and he associated Occupy with his own activism on greenroofs. Another respondent suggests: "technically a greenroof (Deshi interview:2011).

Another respondent with whom I visited the Jubilee Gardens area was less sure. In the large, he admitted it could be a greenroof because of the relationship *with* the roof, but his professional status as a landscape architect meant that he used plants to define whether something was a greenroof or not. For him, the planting scheme reclassifies the roof as a garden or park. Any landscape architect or garden designer, he explained, can design this kind of space without recourse to typical greenroof planting schemes. They are not British wildflowers or the hardy, wind and drought resistant sedum typically forming a greenroof. In addition, there may not be the typical layers of roof protection and liners which a greenroof would possess. There is no need for the greenroof expert here. The landscape architect or garden designer is the 'natural' choice of professional for Jubilee Gardens.

The category is flexible enough to possess different inclusions for different professionals. The interplay of the relationship between plants and roofs becomes a way to both include and exclude within the category. For the Twitter respondent, the roof is key. For Dusty and Deshi, whose mission is to green the city, the relationship to the roof allows inclusion, but for the landscape architect, the planting becomes definitive.

b) when the ground rises to cover the roof

The relationship between roof and greenroof continues to be flexible with the category of earth sheltered buildings. Here, the roof is continuous with the ground and the ground is said to come *up over the roof.* This stands in contrast to buildings which are completely underground (Wells:2009). When the ground rises to cover the roof,

[1] I posed the question on Twitter Is the Canary Wharf underground station a greenroof or not?

the roof and walls often become indistinguishable or inseparable. Plants grown on walls are described as climbers if their roots are in the ground and if their roots are in a substrate located on the wall, they are classified as green walls and many of the benefits which greenroofs accrue are also attributed to them. They might be linked to greenroofs under the classification 'green infrastructure', but they are separate to greenroofs.

The University of Nottingham, Trent favours a roof-centred system of designation and categorizes covered underground parking garages and earth sheltered buildings together, but a differentiation between the two types is made.

> EARTH - SHELTERED BUILDINGS offer some similar design solutions and environmental benefits, but are not technically considered greenroofs. Whereas there is a distinct height separation from the earth with greenroofs, earth shelters form a continuous layer between the ground and the roof. Basically, they are built directly into the earth. Their most similar feature is the energy-saving insulation aspect (Collins:2013).

Examples of earth sheltered buildings are the fictional Hobbit houses in *Lord of the Rings* (Tolkien:2007) and the 'The TubbyTronic Tuperdrome', home of the Telitubbies.[2] These well-known dwellings are what people often refer to when faced with 'greenroof' for the first time (pers. comms.; Proefrock:2007). Not fictional, but still in the Hobbit-style are the Vetsch Earth Houses (Vetsch Architektur:2013), a group of nine one storey dwellings in Dietikon, Switzerland built into a hill and surrounding a lake. In England, the Bath Springs House designed by ZedFactory, "proves that subterranean homes don't have to look like hobbit holes" (WebEcoist:2012). Other examples include the Hockerton Housing estate, a low-carbon development in Nottinghamshire and Vancouver's Exhibition Center. The School of Art, Design and Media at Nanyang Technological University in Singapore provides a hybrid example. It is a contemporary earth sheltered building as the roof and walls are continuous and stretch to the ground in order to allow access accross the full length of the building. However, it is seldom considered earth sheltered because the building is not built into the earth. The earth sheltered roof can be a greenroof because of the plants. However, they are mainly, but not exclusively grass covered and so lack the biodiversity which is sought from other brown or greenroofs.

Another consideration for earth sheltered building is the visual impact it is expected to have on the environment. This was the case for the new visitor's centre at the

[2] www.bbc.co.uk/cbeebies/teletubbies/

Giants Causeway[3] in Northern Ireland, designed by Heneghan Peng architects and completed in 2012. It is formed of "two folds into the landscape," the first one angled up for the visitor's centre and the second angled down to shape the car park (Fearson:2012). The grass for the roof was grown from the seed of local plants in the field just behind the centre. This stakes a claim for footprint replacement and for local biodiversity, integrating both into the existing landscape. In addition, the stone which forms the columns of the building, mimicking the unique basalt columns the Causeway is famous for, is a local stone from Kilrae, formed from the same volcanic eruption as the Causeway stones. For many greenroofers, while the local biodiversity angle might be respected, grass does not fulfil the full criteria of what a greenroof is for. It is not biodiverse enough. Despite the disappointing plant-life and the roof's relationship with the ground, it is still classified as greenroof, online, in design plans and in personal conversations with local people.

c) when it is amenity

Another characteristic of having a roof which is continuous with the ground is that it can be easily accessible, like the Giant's Causeway roof. However, the idea of human use is also contentious and problematic to the classificatory project. For some respondents, using a roof for amenity *downgrades* it to a garden or park. Plants chosen for amenity roofs are chiefly horticultural, vegetable or grass. The same landscape architect, who denied Jubilee Gardens its status as greenroof also denies the Church of the LDS (Greenroof Projects Database:2010) the same designation. Completed in 2000, it is an intensive roof, designed by Laurie Olin and Susan Weiler and landscaped with trees, terraces, balconies and orchestra levels with fountains and water features which can all be accessed by a sloping walkway. Size (20235m² or 217800ft²), access and a physical reference to the biblical imagery of a garden in the desert all combine to identify it as a garden, but sometimes a park, for both the landscape architect respondent as well as Gary Grant (pers. comms.). However, they both are happy to include the roof as a greenroof in training courses.

Jan Striefel, writing for *Landscape Architecture* also wonders whether the Church of the LDS roof is a greenroof or not:

> While a lot of green roof construction is driven by ecological considerations, this design had nothing to do with sustainability and everything to

[3]This is near my home town and I visited the site frequently during and after construction.

> do with aesthetics and image. It's definitely a rooftop garden. Should it be identified as a green roof? (2006)

Striefel separates out greenroofs into "lightweight, environmentally focused" and "aesthetic, garden" roofs (ibid), as do American greenroofers Snodgrass and McIntyre (2010). They represent a large number of respondents who can not imagine the two being synonymous or complimentary, although Osmundson's definition of roof garden as "any planted open space, intended to provide human enjoyment or environmental enhancement, that is separated from the earth by a building or other structure" suggests more of an alliance (2000:13). This definition would then include, not only "gardens in the sky" as he states, but also "atop the roofs of underground structures" such as car parks (ibid:13). Function is one way to identify the category, or differentiate between categories.

The School of Art, Design and Media at Nanyang Technological University in Singapore is easily accessible and designed to be so. But it is not considered a garden or park because it has no trees or institutional-type planting. The High Line, built on the historic, abandoned elevated freight rail line in Manhattan, New York is often included in training courses and in presentations of greenroofs even though it is, as one respondent says "an up-high garden". It has no relationship with a building, but in this case, its amenity and biodiversity values become paramount. There was a furore over its construction, because the brownfield plants which established over the abandoned structure were replaced with a more park-type planting scheme. The Friends of the High Line however, call it a park and indicate:

> The High Line's planting design is inspired by the self-seeded landscape that grew on the out-of-use elevated rail tracks during the 25 years after trains stopped running. The species of perennials, grasses, shrubs and trees were chosen for their hardiness, sustainability, and textural and color variation, with a focus on native species. Many of the species that originally grew on the High Line's rail bed are incorporated into the park's landscape (Friends of the High Line:2013).

The High Line is used to illustrate what can be achieved with imagination, and it is valued for its innovative use of recycled infrastructure, with respondents dreaming of their own version in London (pers. comms.)

Roofs for vegetable growing are often not considered authentic greenroofs either, although they can be included within the designation if required. They are 'green' in

the ecologically orientated sense rather than by the type of planting which would produce biodiversity. The Eversheds roof (chapter six and nine) has an employee's vegetable club. It, like others (BBC:2010) in London attract interest in the media (Adams:2008; Sharp:2008). Many respondents claim that seasonal vegetables do not provide biodiversity. This is typical for greenroof experts who define the biodiverse and specialist roofs that they recommend and build as a special category of roof, dependant upon their expertise. However, the category is so flexible that, if they choose, they can include the garden, park or vegetable roofs.

d) when it is not green

The term 'brown roof' came into existence because the London Biodiversity Partnership (LBP) recognised that when planners began to stipulate a greenroof, the lack of guidelines on what constitutes such a roof was a drawback. Contractors could paint a roof green and this would have satisfied the requirement, Dusty informs me. The name brown roof was coined to indicate that the roof was ecologically similar to brownfield sites:

> to ensure that architects, landscape designers and planners were aware that the kind of green roofs essential as mitigation for Black Redstarts were of a specific kind and character (Gedge 2003b:4).

It started off as an expedient term while at the same time "caused some confusion in nature conservation sectors and the greenroofing industry" which, by the end of the 2000s, has largely subsided (ibid:5). Brown roofs have this colour because of the brick rubble substrate and also because the plants mimic brownfield flora (photographs 9 and 10).

Some sedum greenroofs do not look green either. Sedum come in many colours: red; brown; orange; yellow and silvery grey and some change colour throughout the year. While some sedum do not produce many flowers, others flower extensively adding white, blue or pink to the colour mix. In London, sedum roofs which start off green can often develop a brown look, especially from a distance, due to the predominance of one or several colonising brown or red sedum, like Dragon's Blood Red which is, as its name suggests a deep red.

The issue of the disparity between the name and colour of the Dewey Court roof was raised during an LBZ sustainability team meeting. As photograph 11 shows, from

above, the roof looks green and from below it looks brown. Two of the sedum species planted on the roof, *spurnium* and *alba*, are brown and a third, *sexangulare* can be a dull brown. Residents were concerned about the condition and health of their greenroof. Like others in the block, Mrs B worries about the colour of the roof and wonders whether it is healthy, echoing Mrs P's statement: "it's looked like it's died for many months now. It's hardly lush and green".

> What I have seen of the grass it always looks brown as if it has died, ignore my ignorance if this is indeed how it is meant to look or is due to grow back any day now (Mr R).

The idea of brown signalling ill-health for plants is not unreasonable as Lee (2010) discusses. Injured plant tissues quickly oxidise (like cut apple) and turn brown giving the impression of sickness or death (ibid:80; 146). Healthy plants by contrast are generally green (DaSilva:2004).

e) when it is a neglected roof

The discussion which emerged round the photograph of an abandoned or 'undisturbed' (Johnston and Newton:2004) sod/turf roofed Scandinavian house reveals how authenticity and classification are bound up with intention and more specifically, care. One picture (Doctorow:2010) of a *torvtak* regularly circulates through social media sites. It is striking because the neglect has resulted in several trees growing dramatically out of the roof and it regularly sparks debate. For Gary Grant, an ecologist, this roof is not a greenroof. While sod roofs are deliberately constructed and therefore able to be included in the overall category of greenroof, this particular roof has been neglected, and subsequently, has fallen out of the category. Neglect, which leads to growing unwanted or unintended plants such as trees is not a 'real' greenroof (pers. comm.).

In addition, and less dramatically, domestic roofs which have been neglected and become moss and lichen covered are not authentic greenroofs either. The presence of moss indicates a potential problem with a building's structure because moss grows on damp walls, roofs and the ground. A buildup of moss holds moisture, enabling other plants to gain hold, grow, and over time both the moisture and root penetration will quite literally pull a roof apart. Greenroofers lay the waterproof and root barrier layers to protect against such structural problems. Protection of the existing roof is one vital moral and physical attribute of the greenroofer.

Gary Grant believes that active construction and ongoing maintenance are key to the definition. A greenroof implies intention, even if it is also expected to eventually be self-sustaining. The occasional inspection to demonstrate care is required. Care is also expressed in the intention to attract certain kinds of plants and animals, in the construction and the ongoing maintenance, and Gary claims a guardianship as an ecologist and GI designer. This is care for the building and for nature as plants and animals.

Tom, the ex-sustainability team manager at LBZ takes the opposite position. He believes that the trees on the *torvtak* are the 'natural' end point of a roof. The trees on top of the roof have seeded from the trees in the wider landscape and are taking over the neglected building. He compares this with garage, shed and similar roofs which come about through this kind of neglect, or lack of maintenance. Mossy roofs for him *are* real greenroofs, because they are an inevitable consequence: they have been left for "nature to claim" (pers. comm.). For Tom, it is the ideal of nature, left untouched, to take its course, which shows care. This time, the care is for nature, not for roofs or people.

f) a greenroof by any other name…

Greenroofs are not always called greenroofs. They can be brown, extensive, intensive, living, eco, biodiverse, rubble, earth sheltered and vegetated. Being able to use correct categories to describe and distinguish between roofs is one way of recognising and identifying who is included in the community of practice (Bowker and Star:1999), although as discussed above, this is not always clear-cut and agreed upon. In such cases, the ability to argue convincingly why one differs in opinion on the status of a greenroof becomes vital. There does not seem to be animosity between people who disagree on the category of greenroof-ness. People sometimes joke and laugh in a lighthearted way, argue their reasoning or roll their eyes in disagreement, but generally, they seem relatively happy to agree to disagree.

Sometimes knowing what a colleague will disagree about provides the opportunity to tease. One picture (van den Hoven:2012) of a greenroofed shipping container with a man mowing the grass was posted on Facebook with the intention of gently teasing another greenroofer. The comment directly messaged the target person with the comment that this would "get him going n'est-ce pas?" The joke revolves around the roof as a combination of grass, which is a symbol of monoculture and lacks biodiversity. In addition, even if it were a meadow ecology, the act of regular mowing

is unnecessary and limits biodiversity. Nature is 'natural' when and because it is messy, unkempt. Therefore any attempt to neaten it up is a sign that the person does not know what they are doing. It becomes quite clear to a greenroofer that this is a picture is composed by an 'outsider'.

Many names and types of greenroof have a political, economic or idealistic motivation behind them. As Andrew Garner states: "[n]aming something states what it 'is' and claims ownership of it (2001:144). Dusty Gedge, among other educators and builders, uses the term 'living roofs', as does Natural England (2007) and various academics (Savio et al.:2006) also find it useful. Gedge claimed the name for Livingroofs.org, the non-profit organisation he runs to promote greenroofs in the UK. Living is descriptive and is often used to explain what greenroofs are e.g. green (living) roofs (GLA:2008). It evades the green/brown problem and also points to the underlying reason why the roofs work.

As discussed previously, rubble roofs or biodiverse roofs reference construction methods or intended outcomes. Ecoroofs has become a popular designation across the world. For example, brown roofs are ecoroofs in Portland, Oregon and at the Ford assembly plant in UK (Coffman and Davis:2005; Evans and Associates Inc:2008) to accentuate the ecological diversity. Various academics and ecologists also use this term (Coffman and Davis:2005; Hutchinson et al.:2003). Dunnet and Kingsbury (2004) suggest that ecoroof be used to differentiate between types of 'green' e.g. an environmentally friendly roof achieved by siting solar panels and a planted, living roof. They use the term primarily for extensive roofs. Nature roof is used by Kalzip, to distinguish it from other greenroofing contractors and products (Kalzip:2001b).

As Turkle points out, the differences between categories bring attention to bear on "how we have drawn the lines" (1984:31 quoted in Suchman:2006). As greenroofs are still a relatively new building form in the UK and subject to all kinds of alterations and alternatives, different kinds of boundaries can and are drawn and redrawn. This is a complex blending of need, economics, professional pride and idealism. This should not be viewed as indecision or confusion, but it is a very practically orientated process where the degree of greenroof-ness depends on the context and the audience. The capacity for excess, or 'superfluity' (Buchli 1999:11) contained within the category greenroof or exhibiting the qualities of greenroofy-ness allow it to be adaptable and the result of this is that its meaning becomes context-dependent. Deshi says:

> At the end of the day it's about greening the urban environment, about greening whole surfaces, whether it's a greenroof, or a platform. Its about

making green space (interview:2011).

Naming roofs at LBZ

At LBZ, the flexibility of the greenroof category became troublesome. A regular, fortnightly LBZ sustainability team meeting, held in March 2011, was attended by the whole team of Davina (team leader), Frank (senior sustainability officer), Tamsin (CHP project manager) and Sandra (part time sustainability officer) and myself. In response to concerns expressed by residents living under and near the Dewey Court greenroof about its brown colour, the team discussed a name-change. Managing resident expectation is one of the major concerns the sustainability team take on with their projects. The discussion they had over this was positioned in order to mitigate against the future risk of resident confusion and unhappiness. This needs to be managed successfully as residents have to power to veto forthcoming projects (chapter eight) and complaints are noted against performance, contributing to officer's yearly reviews.

The team discuss a variety of names and their associations. Davina takes the lead and considers nature roof. For her, the associations were with school roofs, of which several in the area are greened. "We're doing nature today" she says as she imitates a teacher in front of a primary school class. When living roofs is suggested she said: "funny, it just sounds a bit ominous, doesn't it?" Living roofs is popular with the others as is eco-roofs. However, for Davina the problem "with eco roof there is the expectation that apart from being green what else is it?" The name eco seems "to imply more – doing more". She dismisses the names eco and living roofs.

Country roof is met with total disbelief and laughter from everyone, as is rural roof. Then garden roof and planted roof are suggested. Garden roof is dismissed completely by everyone because, as Sandra said "then people will want to go on it". Planted roof is " 'not right' " for Frank "as it makes you think of trees". Natural roof is favoured by most of the team. "I like natural because it makes ordinary roofs seem unnatural" Frank declares. Offices have a sense of what they believe is appropriate and what does not sound 'right' such as the suggestions of garden and planted.

Davina's way of looking at things did not make sense to the rest of the group. The others are not familiar with their new manager's leadership style which seems more authoritarian and less inclusive and discursive than Tom's. However, as manager she holds the power to shape decisions. As Strathern suggests: "cutting is a creative

act, it displays the internal capacities of persons and the external power of relationships" (2005:114). The power that Davina holds and the officer's inability to contend with her declarations, means that eco, nature and living, which are the most popular possibilities among the others, and are popular in the wider greenroof network are dropped, because they have personal associations for her. Group consensus for this team becomes the most important outcome and one person's dissent becomes the criteria for rejection of a name.

Frank suggests that different LBZ roofs be called different things. Dewey Court could be a natural roof and Hawthorne Heights a biodiverse roof, he suggests. "And you can pick and choose, depending on the people who live in the building and the environment and the kind of roof". Davina uses the term sculptural to describe a roof planted with flowers round a central pattern laid down in coloured stones. To anyone outside the team, this term means nothing. But because they built the roof, they know what sculptural means. However, for them, it is further evidence of Davina's lack of knowledge and that rankles in a team where the qualified, knowledgeable, long-standing and beloved leader Tom, has been replaced.

However, Davina's chief problem is one of category description. As she says, if she were asked, "how many greenroofs have you got?" the answer would not be straight forward if every roof had a different description. Sandra points out "you need a brand name first and *then* subsets". The decision is made to try 'natural roof' and ask other officers, external to the team, allowing them the power to decide. However, sorting out whom to ask was not entirely straightforward either. Decision making is considered to belong to the senior management or to other departments.[4] Is this a 'forward facing' decision? If it affects the way the council interacts with residents or the general public, then the final decision belongs to the communications manager. However, if it is an internal decision, then a member of the corporate sustainability team (in the environment and culture department) might like to be asked. Finally, it is decided to treat the question as both internal and external. The communications manager and a member of the corporate sustainability team are emailed.

Ultimately, however, the decision was made through Google. The corporate sustainability team member who was consulted searched the suggested terms and decided that it was impossible to change the name because Google has already decreed its legitimacy.

[4]As argued in Dickson (2013) the team were continually making decisions. However, there were definite categories of what constituted a decision, with day-to-day details of how a project operates not counted as decision making.

> if you google 'natural roof' it comes up with all sorts of things! Brown roof is quite common, and although it may not sound as good as natural roof, it is a term that is used quite a lot so many may have heard of it already? And if you research the phrase it comes up as a version of a green roof, which will help residents with understanding (email comm.).

The communications manager declared that "everyone knows" greenroofs are called greenroofs: "the term 'green roof' is so established that it would be difficult *not* to use it". Indeed, there was a deep underpinning throughout all these discussions that everyone thought that 'everyone knows' what a greenroof is.[5] One of the sustainability officers said, in response to a name change: "they're gonna say 'what is that'? They always refer to it as a greenroof - they're not gonna know" (Tamsin). When I suggest that most people have never heard of a greenroof they are shocked. Many social housing residents do not possess computers so they can not access the internet with the same facility that officers can, which is something they frequently forget. In addition, while the team recognise that they are "way ahead of the curve" (Frank pers. comm.) in terms of innovation and sustainability projects, they often fail to recognise their position as market leaders and what influence they have. Davina finally decides to keep the name greenroofs rather than change it because it signals the category, if not the individual roof. However, she suggests the best remedy is to make a poster entitled: "How good is your greenroof?" or a sign "I am a greenroof – why am I brown?" This taken-for-granted lack of personal contact officers have with residents both enables and frustrates their work. Any problem which can be should be tackled without face-to-face communication. It also shifts the onus onto individuals to read, understand and accept the information. The proposed placement of the sign along the corridor under the roof, means that those who can see the roof cannot read the sign, and those people living under the roof who can see the sign cannot see the roof properly.

The Affordance of Scaling

The prevalent view is that from geological to global to personal via carbon targets or governmental responses, "[f]or better or (mostly) for worse, global warming is all about scale" (Kolbert 2007:3). Scale is taken by many disciplines, biology, ecology,

[5] I met a huge number of people during my fieldwork year who had never heard of greenroofs. One person thought I was talking about copper roofs which had weathered to a green colour and we talked at cross purposes for some minutes before this was clear.

and some geographers to be a fundamental, irreducible category (Sayre:2009). Levels are theorised as hierarchies and biophysical systems are still largely using this classification and this constrains thinking in a linear fashion. Theories such as holism and chaos theory are employed in order to account for unpredictability within systems because there is an underlying assumption of a steady-state or balance which has to be reached and accounted for. Size, for example, is often expressed as a scale, but it is not an indivisible unit of analysis: size is relational.

> Scale as relation requires a strong conceptual distinction from level. It is, so to speak, an order removed from scale as level, defined by the spacial and temporal relations among (processes at different) levels (Sayre 1995:101).

Scale, both spatial and temporal is a gestalt, each part affecting and being effected by the other parts, mirroring Chemero et. al.'s argument that affordances are "relations between the abilities of organisms and features of the environment" (2003:189).

What is measured and how, become socially based decisions or agental cuts (Barad:2007) and therefore have ontological implications (Sayre:2009). What these cuts also do is provide the affordances or possibilities for movement (Strathern 2005:112-3). Because scale is socially constructed and relational, it is also historically contingent and changing. The following discussion focuses on the sod or turf roof with other examples as necessary, and discusses how scales of time, size and level are re-articulated by the materiality of the greenroof. Four reconfigurations are identified: time, location, size and level.

Past to Present

Roof gardens are often drawn on to provide more historical evidence to imply that not only is the category of greenroof a normal architectural form, it is also a popular and long-lived one. Historical examples are given in books (Osmundson:2000) recommendations (English Nature:2003), training courses and websites. They include roof gardens buried during the eruption of Mount Vesuvius in AD 79; the monastery at Mont Saint Michel in Normandy built in the 13th century; Renaissance roof gardens built by Pope Pius in the 15th century and the roof gardens built on the Kremlin and the Hermitage in Russia. The Hanging Gardens of Babylon are quoted by almost everyone (English Nature:2003; Osmundson:2000; Dunnet and Kingsbury:2010;

Ngan:2004; Dinsdale et al.:2006). As discussed above, the roof garden can be included when necessary, to demonstrate how roofs can be social spaces and useful for concerns over food security.

Sod or turf roofs are included in the classification greenroof because they also form a temporal link with an idealised past. The *torvtak* discussed above started out life as a sod roof. This is a building type historically used in Scandinavia and migrated with the Vikings to Iceland, Ireland and Scotland (English Nature:2003; Oliver:1998), and from there to the US and Canada as settler cabins:

> for hundreds, if not thousands, of years, mainly due to the excellent insulative qualities of the combined plant and soil layers (sod) … Canadian examples of early green roofs, imported by the Vikings and later the French colonists, can be found in the provinces of Newfoundland and Nova Scotia (Kuhn and Peck n/d:2).

While Dunnet and Kingsbury (2004) also add Kurdistan, Japanese and Chinese roofs to the list, Ionas, in the *Encyclopedia of Vernacular Architecture* (Oliver:1998) describes how sod roofs are found all over the world.

In addition to the insulative benefits, the sod roofing technique "maintains the freshness of the house," through cooling the building in hot climates (ibid:355). This kind of architecture is still evidently in use on the Faroe Islands and elsewhere. One respondent, whose wife is Norwegian, built a holiday home in Norway, laying a sod roof on the property (photograph 7). He explains that the roof is constructed by placing water resistant birch shingles on top of boards and then topping with turf. Two layers of turf are used, with the plant layers 'sandwiched' together (pers. comm.). The turf becomes compacted by the vigorous roots of grasses and plants and by heavy winter snows and this holds the shingles in place during high winds and rain. They are generally placed on sloping roofs, which aids drainage and this is unlike most contemporary British greenroofs, which are laid on the flat. While Peter is enchanted with his greenroof, he reports that the experience of staying in the house is "normal, nothing special." He supposes that the roof keeps the house cool in summer and warm in winter, but can not really evaluate this. However, it is this image of a building form which has been in continuous use for hundreds (if not thousands) of years which positions it as a legitimate roofing material. Enchanting but normal simultaneously.

The widespread use of sod roofs in Northern Europe confers legitimacy as the inspiration for the contemporary architectural form for which they afford authentication.

This is accomplished by referencing an idealised past, where the peoples of Scandinavia and elsewhere are in touch with nature. Much ink has been spilled about both the appropriation of the past and the cultural other (Brosius:2006; Escobar:1999). However, this strategy of arguing for continuity of form through time and through folk or vernacular use in the present, is highly productive for my respondents, which is why they continue to use it.

This harkening back to an idealised, romantic past is something few greenroofers acknowledge, the exceptions being Dunnet and Kingsbury (2004). The vernacular style, borne out of necessity to insulate housing, using the best use of local materials to hand couples now with the possibility of its reinvention as a contemporary form. Harkening back, to build in the present, to be fit for the future. At the core of this lies the principle of Nature as a resource and as a wilderness, reframed later as 'naturalness'. It has recently been argued that this was a much more complex co-production of landscape and Nature, than the simple, uncritical and straightforward example of utopian utilitarianism versus a utopian wild and romantic landscape (Hill:2012; Spencer:2012). Jan Striefel (2006) describes how the Church of the LDS was designed to mimic an historical local biodiversity which the architects Olin and Weiler describe as high-mountain meadow habitat. They imagine the scene early Mormon pioneers encountered and built this into the roofscape as a visitor experience:

> When they reach the top, looking out over the meadow to the mountains beyond provides a sense of the vastness of the western landscape, but the space is designed so that visitors don't have a sense they are standing on top of a 21,000-seat auditorium (Weiller quoted in Striefel:2006).

There are however, several major differences between the vernacular sod and the contemporary greenroof. Firstly, the stabilising affordances of grass and grain roots were employed to keep the roof from slipping while simultaneously their penetrative capacities were kept in check by sprinkling salt beneath the turf. Rye (Secale cereale) was planted for this reason (Dunnet and Kingsbury 2004:16). These allowed a greater roof slope than contemporary British greenroofs which are often flat. There are a few examples of sod roofs of the Scandinavian type in the UK which were built in the 1970s such as the Wildfowl and Wetlands Trust Visitor's Centre, Martin Mere, Lancashire[6] and the National Centre for Alternative Technology, in Powys, Wales, both built to demonstrate the viability.

[6]Laid in 1975, it is composed of locally cut turf, one layer grass-side down, the other grass-side up. Skylarks, finches and thrushes have all used the green roof and mallards breed there (Johnston and Newton:2004).

The second major difference between the sod roof and the contemporary greenroof is in the planting. This lays the sod roof open to accusations of a lack of biodiversity because it is simply planted with grass or grain. Over time the sod roof will achieve much of the local biodiversity through seed dispersal. The *torvtak* photograph (Doctorow:2010) shows how abandonment leads to this condition, where the surrounding trees have simply seeded themselves onto the abandoned roof. Over time, the roof and surroundings mimic each other. The sod roof may be useful for demonstrating how a building technique achieves continuity through time, but the biodiversity it delivers is inadequate for the contemporary roof which has a specific biodiversity and is required to also provide ESS.

Country to City

The second major shift from the vernacular sod roof to the contemporary greenroof is its relocation from the countryside to the city. This may be a further affordance of the sod roof, that it can confer just enough recognisable form and substance to make this move possible. Not only are contemporary greenroofs seldom sod roofs but they have long since shed their vernacular qualities. The vast majority of contemporary greenroofs are also chiefly located in cities. The notable exceptions, such as the Giants Causeway visitor's centre are designed to have minimal visual impact on the countryside. In the historical, vernacular form they sit on domestic and church buildings. However, in London the vast majority are sited on commercial and school buildings with only a few domestic and no church roofs (to my knowledge).

One respondent sought my advice about his plans to lay a greenroof on his house in the Yorkshire countryside. However, in the end he concluded: "guess I must confess to remaining a greenroof sceptic - at least for rural areas, where there is plenty of cheaper and less demanding green growth at hand" (pers. comm.). This respondent regards the countryside as being green enough and the greenroof as a predominantly city form. In the move to the city, greenroofs have also been reinvented in terms of use. They are specifically built to adapt to changes in the climate, especially in terms of water attenuation, air quality and biodiversity. This has led to a proliferation of forms each designed to perform to agreed standards for a variety of criteria or ESS.

Local to Global

Richard Wilk (1995) describes the 'basic paradox' of the local/global interaction of scale and how global forms become locally and culturally situated. In expressing local difference, the global is reinterpreted (see also Miller:1998). The global creates "larger relations of uniformity, casting local differences in ways that, on a global scale, are predictable and surprisingly uniform" (Wilk 1995:110). Roy D'Andrade also describes how multidimensional scaling draws out general relations of similarity and ignores minor differences in categories in order to think through "those features which are most general and most salient in structuring a domain" (1995:69). The greenroof alters through context but remains recognisably the same form, through different scales and in different contexts. A global and a local form simultaneously, all can be recognisable as living plants on a roof.

The contemporary greenroof, having migrated from small, vernacular dwellings, has also grown in size. Some of the largest in London are the TFL West Ham Bus Garage at 4000m^2, Kings Place at 5000m^2 and Dalston Square at 8000m^{2,} (GiGL:2013). This is made possible by the standardised sedum mat. However, included in the same category is the shed in my neighbour's garden, with its hotchpotch of sedum and wildflowers, and which is only 2 m^2. It can also be recognised as a greenroof.

Working at scale using international examples of 'best practice' allows certain aspects of greenroofs to submerge and others to surface. Plants are easily capable of being understood and transferred through different registers. Plant types are fused, digitized, quantified and translated into policy where they are able to move between scales, through databases and across international borders as digital and imagined future actors, envisioned to regulate the urban environment. Materialised through photographs, architectural plans, biodiversity, and ecosystems services which operate as ways of designing and excluding, counting and placing nature.

What is recognised as a global form is covering a roof with plants even though, as discussed this definition can be problematic. So the vernacular Scandinavian sod roof can be presented pictorially at a high level seminar in London as a legitimising form which spans international, historical and ecological boundaries, bringing its environmental benefits of insulation and biodiversity with it, even though, once an agreement to build greenroofs is secured, the sod roof becomes irrelevant. In different contexts, or stages of negotiation, this same sod roof will *not* afford and be productive of sufficient biodiversity and other forms of planting will be substituted. Once the idea of planting a greenroof is accepted then differences start to be imag-

ined in the form of plant localism and biodiversity. Sedum comes into its own as an international plant here. It is capable of naturalisation and survival in most European countries, Australia and on the South and North American continents. At one level the flexibility of both the plant world and of sedum allows a uniformity and in other contexts, as a large species with 500 variants, it produces variety with the addition of local plants which can supplement the roofs and will also self-seed.

Moving through Categories

In addition to being included or excluded at will, some roofs show a different capacity to move easily between categories. This can be accomplished through retrofitting with features which will attract wildlife or by seeding areas with different kinds of plants.

> In central London there is a lawn of luscious green, in which insects merrily scurry. Feeding on them are birds, which can nest nearby in specially installed wooden boxes. They are observed by office workers eight storeys above ground level, where a view of Saint Paul's Cathedral matches any vista in the capital (Sharp:2008).

Built as part of a law firm's sustainability plan for their new headquarters, Eversheds greenroof was also a legal requirement enforced by the GLA. The building took Best Corporate Workplace in the south-east of England at the British Council for Offices awards in 2009 for their range of energy saving features (Eversheds:2009). It was designed by the Green Roof Consultancy Ltd., and installed by Skygardens using their own greenroof system in 2008. At 1500m^2, it was considered to be the largest greenroof in the UK at the time. It is a U-shape with two long sections of sedum matting running the full length of the building, joined at one end and separated by a large air conditioning plant. A small section of roof at the opposite end is gated for health and safety reasons and one section provides an employee's vegetable garden (photograph 2).

The roof was originally laid as a 20mm sedum mat, lying on 20mm substrate and a drainage layer of sponge and is the first example of greening beneath roof trolley rails.[7] Dusty Gedge was commissioned soon after laying the sedum mat to increase

[7]The steel tracks which run round roof perimeters of tall buildings to allow trolley systems to be suspended. These are used for window cleaning and maintenance.

the biodiversity. Over the years he has retrofitted it to develop it as a biodiverse roof with the addition of 20 sand mounds (wildflower substrate) up to a height of 150mm for plants such as kidney vetch (*Anthyllis vulneraria*), salad burnet (*Sanguisorba minor*), wild mignonette (*Reseda luteola*) and common rockrose (*Helianthemum nummularium*). Also added were logs (photograph 2) to encourage Stag beetles (*Lucanidae*), dried wildflower hay bundles and native seed mix. Bird boxes have been placed for nesting birds. "These elements … are intended to increase the invertebrate biodiversity and provide a template for retrofitting features to existing sedum roofs to increase invertebrate diversity" (Gedge et al. 2011:17). Dusty speaks of this roof as an important example of how to retrofit a sedum mat for biodiversity. This ability to retrofit roofs by adding features for biodiversity is the reason he and others are, not happy, but willing to compromise on the sedum mat roofs. Dusty combines visits to the roof with hosting his courses in Evershed's meeting rooms and a visit to the roof (photograph 2) is always part of the day.

The first training course I attended was held in this office complex and our group was invited to 'seed bomb' the gated area of the roof. We were all given party poppers which one member of the group had emptied and refilled with wildflower seeds, replacing the cardboard bottoms carefully. Each one had a label with a description of the seeds it contained, a little drawing of an insect the plants were expected to attract and everyone had a slightly different mix. The seeds were carefully chosen to attract bees and included Birdsfoot trefoil (*Lotus corniculatus*), Lady's Bedstraw (*Galium verum*) and California poppy (*Eschscholzia californica*). We 'pop' these to scatter them. This controlled act of mimicking the more transgressive guerilla gardening pleased the group very much and there are shrieks of enjoyment.[8] On subsequent visits, I see that the plants have established easily and are promising to flower.

This roof is large enough to have different sections and as time goes on the retrofitted sedum roof is able to be encouraged through different stages, although it will never be able to accommodate the kind of 'full biodiversity' a brown roof could support. A similar management intervention occurred on the Waitrose building greenroof in Canary Wharf, London. This is a 600m^2 sedum mat which was laid, unusually, on crushed brick ballast. Wildflowers seeds were sown and the roof also attracts windborne grasses, resulting in the move to a grassland ecology (Kadas:2007).

[8] I, myself was thrilled too (but no shrieking).

Ontological Completeness

The relationship which living plants have with the roof or a roof-like structure is a fundamental characteristic of the greenroof. Greenroofs therefore may not be ontologically distinct entities because they depend on this surface to manifest. Can an object which depends upon another for its materialisation claim ontological completeness? And does this matter? Like graffiti, greenroofs sit on the surface of a building. But while paint fuses with the surface, becoming a 'joined materiality' (Schacter:2014 forthcoming; email comm.), greenroofs do not fuse or join. The barrier, thick and impenetrable, separates a greenroof from the structure it lays on. To fuse would damage the lining, weakening it and causing it to leak, so a great deal of time, effort and money is spent ensuring the two remain separate. It is also possible to lift and remove the greenroofing without destroying the roof surface, unlike graffiti removal, which destroys some of the wall's surface (ibid).

Unlike graffiti's double life, destructive to some (Dickinson:2008; Megino:2012) and productive to others (Monto et al.:2012) greenroofs do not hold a position of matter out of place, a double ontological condition, caught between "decent or decadent action" (Schacter 2008:37). Although, they do have effects which overflow and become problematic for some. The aesthetics of the living roof have to be carefully learned to be appreciated especially to overcome the green/brown issue. This challenges the idea that agency, as an ability to "capture, hold and transform cognitive operations," is in some way natural, obvious or immediate, in a state of offering (Hirsch et al.:1997:25). This is accomplished through seminars and courses and supplemented by the books, websites and photographs which circulate on the internet. Most importantly, while graffiti might have a secondary, Gellian agency as Schacter (2008) argues, it is in and of its own materiality, sterile, lifeless and can not change the physical city and other living beings *as a greenroof can*. It is this quality of aliveness and vitality which changes the material nature of the cityscape. Graffiti requires the presence of a human to produce it and an observer to be enchanted, plants do not, and the greenroof actively and continually protects and cleanses the city even without a human observer present.

Sanders (1997) argues that the colour red is not an affordance because it depends upon an object for its existence. In purely philosophical terms, if an object is ontologically complete and holds red as a quality, it can still offer this colour as an affordance. Red can behave like an affordance in certain circumstances (collecting, displaying) and does not have to be ontologically complete to do so. Greenroofs are not qualities

of a roof. They are separate objects placed on a roof and, just as the roof affords greenroofing, they, in turn offer affordances. They may not ontologically complete, however, they behave as if they are. If an object possesses affordances does that make it ontologically complete? No, but its incompleteness may turn out to be an affordance. For example, the greenroof forms an effective configuration with the roof and has a relationship with geographical place in order to define its integrity as an object. This means that it is able to maintain fuzzy boundaries, producing scales of greenroofness which can be manipulated by anyone designing, laying, selling, categorising or being-on greenroofs. This slipperiness of category turns out to be an affordance. It enables members of one community of practice to test to see who is a competent and knowledgable member of their community and determine who does and does not care about nature. It enables joking and teasing, as well as serious considerations of what nature and naturalness might be. And it enables different forms of greenroof to be accessible to ecosystems service provision, because plants possess agentive capabilities.

Is a Greenroof a Technology?

The question of whether a greenroof is a technology or not comes up occasionally, too. All my respondents agree that because the supporting material layers are technologically constructed they are artificial. However, while some are happy to think of the whole configuration as a technology which preforms functions in the human ecosystem, others forcefully reject the categorisation. Eric Katz (2011) argues that any environment produced by humans cannot qualify as natural therefore, it is impossible to restore or re-create a 'natural' environment. He insists on a difference between nature (as untouched by human agency) and artefact (produced by humans). For Katz, the greenroof would be an artefact, an example of "hybrid systems" (ibid:74). For my respondents also, this is true. However, there are differences between them. Gary Grant, for example describes the greenroof as living and therefore it can not be defined as a technology, nor can it achieve un-naturalness (pers. comm.).

Respondents always refer to the plants when they speak of a greenroof. They regard the physical layers constituting the base of the greenroof system in a supporting role. It achieves a similar position to the hedgerow, currently a site of environmental concern, protection and Britishness. This was Porter argues, a: "product of Georgian agribusiness, landscape gardening and peasant cleansing" (2001:17). Hedges are simultaneously a technology, and living, natural, plants. It also demonstrates that what

actually constitutes Nature has also changed over time. Hedgerows work and become sites of biodiversity protection because they demonstrate plant's agentive capacities. The human-made artefact, the greenroof, has the capacity to hold the status of artefact and natural simultaneously. Like the hedgerow, over time it will become *more* natural. In terms of affordance theory, plants do not care whether they are planted by humans or grow from wind-borne seed, if the conditions suit their needs, they will grow. The plant's indifference is what makes the greenroof possible and what, in the end, greenroofers use to create nature.

Conclusion

Classificatory systems are used to think – creating the "positive basis of knowledge" (Foucault 2001:xxiii). The materiality of the plants and the greenroof layers act in an effective configuration which affords 'superfluidity' (Buchli:1999). This enables a range of types to be drawn together under the classification greenroof, and for them to slip productively between categories as required. Categories and types describe, they demarcate group inclusion and they produce reliability and moral order (Bowker and Star:1999). Where the boundaries merge a hybrid, productive space is produced for people to work through and manage multiple ontological tensions and notions of nature and naturalness in order to produce "the confident intuition of self-evident truth" (Douglas 1975:209). These fluid classificatory systems shape the form and manufacture of greenroofs as succeeding chapters will show. This allows greenroofs to operate successfully at the utopian ideological register and in a pragmatic, material register and how one is productive of the other. The next chapter begins to show this achievement, by examining in detail how greenroofs are produced and shaped through policy, within London and LBZ.

8

Practice and Policy: Affording Ecotopia

> A policy finds expression through sequences of events; it creates new social and semantic spaces, new sets of relations, new political subjects and new webs of meaning (Shore et al. 2011:1).

The benefits of greenroofs are assembled, quantified and positioned as a commodified solution to the conditions of climate change, compiled into the well-used term "mitigation and adaptation" within systems of evidence based policy making at the city and local levels. Greenroof benefits intersect multiple policy realms and reassemble them in new formations resulting in new constellations of social relations and "webs of meaning" (ibid). This chapter will describe the policy landscape into which greenroofs enter in London. Then, it will show how greenroof policy is made at LBZ in order to show how the local and city policies form a palimpsest out of which further policy can be made.

Plants and greenroofs play out spatially, not only on the roofs of people's homes, but in the distant locations of multiple offices, research facilities and have a separate existence on forms, in policies and documentation which support and justify decisions made in these distant locations, a phenomenon typical of the aesthetics of contemporary bureaucracy (Riles:2006). One way in which greenroofs exist outside their spacial location is within policies and this is argued by almost all my respondents to be essential to the success of greenroofs. In practice, as the last chapter demonstrated,

variability in form and categorisation is an affordance, but within bureaucratic systems, the greenroof's ability to be standardized and moved with ease between registers, contexts and social actors becomes the most useful affordance.

Dvora Yanow asks: "Is 'policy' the formal documentation that is the outcome of a legislative act? Is it a set of inclinations, as in 'The British Government's policy is…'? Is it a specific programme?" (2011:305). It is all of these: a formal and legally binding obligation, a practice and a specific course of action. This chapter will follow Shore and Wright's (1979) and Shore et al.'s (2011) interpretive, anthropological model of policy examination, exemplified by their own volumes. This chapter shows five distinct features of policy-making: the process of making new policy; policy which develops out of institutional practice; how internal policy-making is constructed in reference to public policy; the policy process as recursive and lastly, how mainstreaming is achieved through policy. In the first section, I use Yanow's question "what work is a policy doing?" and in the second section, adapt her question to: what work is policy-making doing? (2011:305).

Policy Palimpsest

Respondents talk about the importance of policy as a route to governance. Dusty explains why: "without a policy greenroofs would be a choice and therefore would rarely be installed" (interview:2011). Policy is legitimisation, a pattern for implementation and an incentive, driven by targets. Greenroofers often lament the lack of national policy on greenroofs and many recognise the GLA as the most important level of greenroof governance because of the pressure on targets it can exert through local authorities.

Pam Carter (2012) describes how an individual policy can be likened to a palimpsest, in order to describe the way it accumulates, develops, changes over time and results in unimagined consequences. However, in this case, there is an existing palimpsest of different policy areas which can be re-assembled to produce convincing evidence for how greenroofs and their benefits can fulfill multiple requirements simultaneously. Existing policies, acts of Parliament, National and Local Indicators, Action and management plans can be mobilized as "tangental hooks on which to hang green roof proposals"(Gedge and Firth 2004:31).[1]

[1] A similar policy palimpsest exists in the US. For a quick overview see: http://www.myplantconnection.com/green-roofs-legislation.php

They can be classified by type:

a) Laws and Acts of Parliament

b) Policies

c) National Indicators

d) National, regional and local assessments, plans, codes, strategies, planning policy statements.

They can be classified by scale:

a) International: The Bruntland Report; Agenda 21

b) National: The Flood & Water Management Act 2010; National Indicator 188: Adapting to Climate Change; PPS1 Delivering Sustainable Development

c) City: The Regional Flood Risk Assessment (RFRA); Local Performance Indicator 16.2 Number of Green Roofs in The City of London; The London Plan

d) Local: The LBZ Air Quality Action Plan (2009-12); LBZ Green Action for Change

They can be classified by subject:

a) Water: The Water Act 2003; The Surface Water Management Plan (SWMP); Policy SC 16 Flood Risk 2009; Regional Flood Risk Assessment (RFRA); The Mayor's draft water strategy, August 2009

b) Biodiversity: The Wildlife and Countryside Act 1981; UK Biodiversity Action Plan; Green Grid Framework Spatial Development Strategy for Greater London Draft SPG (2007); LBZ Biodiversity Action Plan (BAP)

c) Sustainable development: Policy CS13 Sustainable Development and Climate Change 2009; Securing The Future: The UK Government's sustainable development strategy 2005; The Code for Sustainable homes

d) Air quality: the UK National Air Quality Strategy; (London) Air Quality Management Action Plan; Local Performance Indicator 13.2: Air Quality

e) Environment: Nature, Environment and Rural Communities Act 2006; The Environmental Protection Act 1990; The London Plan

f) Energy: Energy White paper 2003; the EU Directive on the Energy Performance of Buildings; Building regulations, Part L

These, plus reports and recommendations from organisations such as Friends of the Earth, National Trust, Energy Savings Trust and English Heritage have become authoritative in LBZ within evidence gathering strategies.[2] These policies, targets and recommendations are materialisations of the concerns of the organisations which govern the urban environment of London and the UK more generally and in reality these levels, types and scales become intertwined through practice. They vary in the amount of influence and authority they hold, according to context. Whereas policies are often seen as acting on publics (Shore et al.:2011 following Foucault), environment policies are often perceived to act upon materials or materiality (waste, air pollution) and tend to have a geographical or spacial focus (brownfield sites, London). Greenroof policy at the GLA level is geographical, material and person orientated.

Policy and Uptake

London council attitudes to roof gardens and greenroofs has varied widely between councils (HATC:2006) and changed over time. In 1987, LB Wandsworth (2/6/87) held that a roof garden would be suitable for amenity space requirements. However, a year later, LB Redbridge argued: "a roof garden on the top of a five storey warehouse conversion would be 'an unattractive place for a considerable amount of the year'(1/9/88:5). Roof gardens were considered a problem by LB Hammersmith & Fulham (20/3/87) because they believed that others could be overlooked by people on those roof gardens. However, by 2008 *Living Roofs and Walls: Technical Report: Supporting London Plan Policy*[3] recognises the drive to a more compact and ecological city and exclaims"it is time to make our roofs places for life" (GLA 2008:1).

The Technical Report describes the uptake of greenroofs as "piecemeal" and recommends: "there has to be wide scale uptake of the technology across London; something that will only happen when firm policy guidance is issued" (2008:45; 43). The principle change marked by the London Plan is a shift in emphasis from encouragement to expectation. GLA planners now "expect major developments to incorporate

[2]When asked why a particular Friends of the Earth framework was chosen for LBZ, the (now ex) elected councillor for sustainability was at a loss to explain. Her personal history as an activist, her trust in the organisation and the ease of alignment the organisation now has with local government through research and framework provision all make it 'natural' for her to choose them.

[3]For brevity, *The Technical Report*.

living roofs and walls where feasible" (2008:1). The GLA has a "target to increase green cover in central London by 5% by 2030" (London.gov.uk:2013) and expects the London boroughs to implement this in their Local Development Framework (LDA) policies through the adoption of greenroofs in smaller developments and on building extensions. The Preferred Standard is:

> 'A minimum of 70% of the roof space should be vegetated to provide maximum benefit for SUDS, building energy performance and biodiversity. At least 25% of the total roof space in any one development should be accessible to residents and/or workers.
>
> A roof with an average depth of 100 mm substrate with 80% of the substrate having an average holding capacity of approximate 2 litres/10 mm/m2 equivalent providing a potential minimum capacity of 20 litres/m2 (GLA 2008:47).

"Policy made greenroofs mainstream in London," Dusty says as he describes what a success story this is. He wants this kind of policy to be introduced throughout all the boroughs. Frank and the sustainability team at LBZ also want to see this implemented, with a further emphasis on retrofitting existing buildings. Despite GLA recommendations for policy and despite the argued causal link between policy and uptake, this has been variable in London (See Appendix II). The word 'preferred' and the ability to offer a defence if the designer or architect prefers not to lay a greenroof because of an innovative roof shape or aesthetic (e.g. Zaha Hadid's Olympic swimming pool) means that the policy is currently more of a recommendation than a necessity. Its uneven application means it is an ongoing process towards full implementation.

As Appendix I shows, some local authority areas have very few greenroofs, while others are major contributors to the estimate of just under 700 greenroofs (GiGL:2013). The GiGL yearly database figures are, I believe, conservative because they rely on self-reporting and there are numerous buildings I have personally observed which are not reported. Roofs vary considerably throughout London, with central roofs more likely to be commercial, larger and flatter than private and sloping suburban ones and therefore more amenable to greening. GLA policy recommendations are often easily ignored, inconsistently taken up and variably interpreted. It is also equally likely that many local authority officers are unaware of the potential of greenroofs. While discussing greenroofing with officers from two councils, LBX and LBQ, it became clear that very different strategies were in operation. Members of the estate

management team at LBX which is near the bottom of the GiGL table, knew very little about greenroofs and their first priority was to install solar PV on their resident's homes. At LBQ, which is near the top of the table, the response to the government's funding cuts has been to push the agenda of 'enablement' much further than LBZ. LBQ will not build greenroofs, but the intrepreneurial officer interviewed will help people and organisations to apply for small grants. Most of the sustainability team and the members of the wider greenroof network blame the uneven uptake of greenroofs on a lack of consistent policy. It is clear, however, from working within LBZ and through contact with other authorities, how important the officers are in acting to make policies take life.

Recursive Policies

The *Oxford English Dictionary* suggests that recursion originates in the "late 18th century from late Latin recurs- 'returned' (from the verb recurrere 'run back')" and defines the contemporary usage as "recurrence or repetition" particularly in mathematics, linguistics and computing (OED:2013e). Drawing on Edgar Morin's work on complexity and system's theory (1986; 2008) policy literature has featured recursion since at least the early 1990s where policy-making is considered a reiterative process (Hill:1993) with the relationship between policy and implementation demonstrating interactions and recursion (Stewart:1996).[4] Crozier (2007) argues that this further leads to recursive governance. Recursivity in this case is contained within the processes of policy implementation with subsequent evaluation and redrawing of the original policy. This sets up a recurring cycle of implementation, evaluation and amendment. In the greenroof case, recursion is differently materialised and is contained in the repetition of the wide (already in place) policies which continue to build the palimpsest of authoritative knowledge which is then used as a base to make further policy.

As officers 'copy and paste' from earlier documents to new ones, they rely on their or colleagues' previous work. The familiarity builds knowledge and authority and becomes recognizable over time as a "generative informational logic" (Crosier, 2007:2). Chris Kelty (2008) also uses the idea of recursion to outline his anthropological theory of recursive publics. Over time, a bureaucratic aesthetic builds, where information: digital, stylized, standardized, idealized, formed into 'lessons learned' and 'best practice' has consequences for governance, through policy. Information becomes simpli-

[4]Therefore policy making and implementation cannot be separate processes, as previously argued.

fied through the production of reports to management (Tufte:1997; 2001). Research findings become known as facts during this process and recursive action makes the information known, understood and authoritative. Trust is implied by the management of the front line workers who produce these reports and this is shown through sections entitled "key evidence base" which are where the recursive patterns are stored and referred to. The recursion which sets up this bureaucratic aesthetic is examined in the next section.

The Local Development Framework 2010-2025

London authorities contribute to GLA targets through Local Development Frameworks (LDFs)[5] which knit national planning policy, community strategies and the London Plan into local frameworks through the LBZ Core Strategy (CS). The CS describes LBZ's vision and objectives, and it contains the strategic policies for the borough through which all actions are measured. All of the 19 CS points have a sustainable base reflecting a low carbon, low waste vision. While none of the sections mention greenroofs specifically, *Section 3: A Sustainable and attractive LBZ – Tackling climate change and improving and protecting LBZ's environment and quality of life* (CS 13-19 inclusive) can be invoked to support greenroofs by aligning the low carbon, low waste agenda with climate change; protecting and (where possible) enhancing the built environment, heritage and open spaces. The key evidence base for this section includes The *London Plan* (2008) and the *LBZ Sustainable Community Strategy; 2007-2012*.

Three Core Strategy Policies (CSPs) outline support for greenroofs. CSP13 - *Tackling climate change through promoting higher environmental standards* links green and brown roofs with lower air temperatures, water and surface flooding and carbon reduction measures. It anticipates an increase in stress on water management and the urban heat island effect in the future and outlines the protective effects of open and green spaces for cooling the city. It also suggests making eco-grants be made available for greenroofs (13:28:120). *Under Water and Surface Flooding* 13.23 – 13.27, there are general conditions for SUDs and references to LBZ's *Development Policies (DP23 – Water*) for further clarification. *CSP14 - Promoting High Quality Places and Conserving our Heritage* section on landscaping and public realm outlines how this can be beneficial for wildlife and visual attractiveness:

> We will encourage appropriate use of landscaping in the form of 'green

[5]This replaced the previous *Unitary Development Plan.*

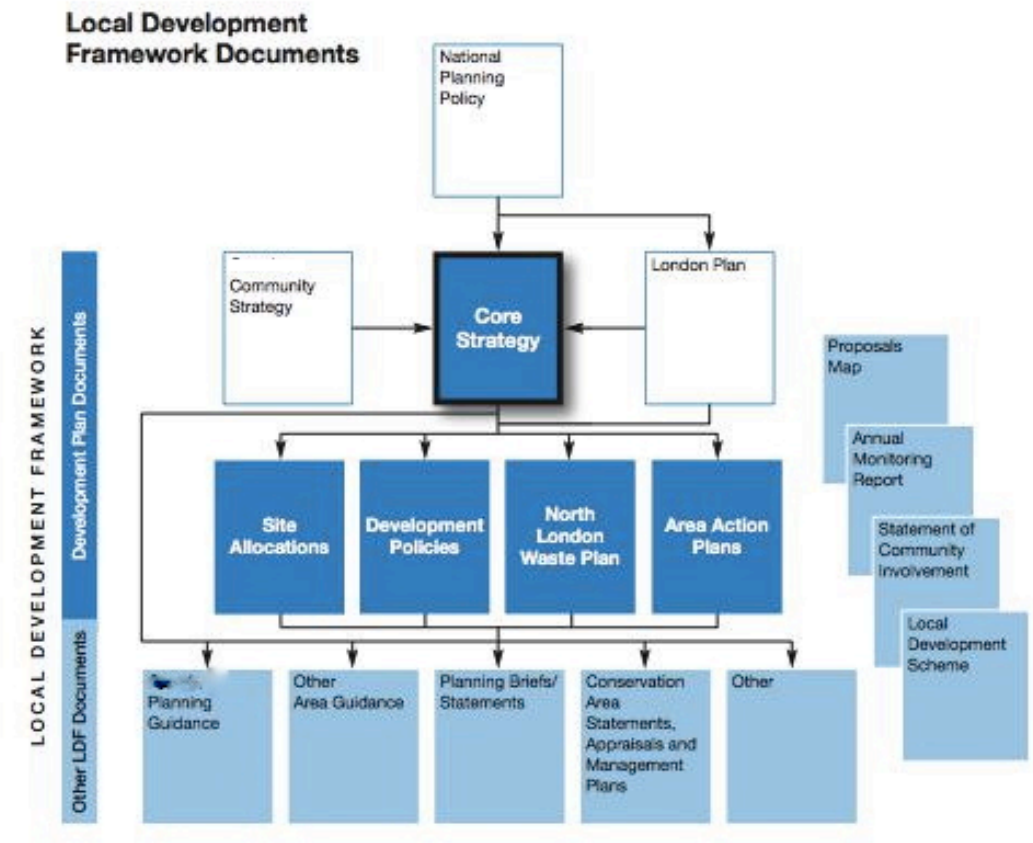

Figure 8.1: Diagram LBZ Core Strategy: Introduction (2010:5)

> roofs', 'brown roofs' and 'green walls' which have a number of environmental benefits (e.g. in providing wildlife habitats, in helping to cool and insulate buildings and in retaining water, helping to reduce flooding), as well as being visually attractive (CSP14:124-5).

Again, further referencing is made to *LBZ Planning Guidance* Supplementary Document and *DP22.* The evidence base includes: *By Design: Urban Design in the Planning System – Towards Better Practice* (DETR/CABE:2000); *Planning Policy Statement 1 – Delivering Sustainable Development* (ODPM:2005), *The London Plan* (2008); *London View Management Framework Supplementary Planning Guidance* (GLA:2007) and *Sustainable Design, Climate Change and the Built Environment* (CABE Briefing:2007) and *CSP15.*

CSP15: Protecting and Improving our Parks and Open Spaces and Encouraging Biodiversity details the way the projected increase in population of the borough is to be balanced with the maintenance of open spaces, which are now under pressure to be sold (chapter nine). Section G of the policy expects "the provision of new or enhanced habitat, where possible, including through biodiverse green or brown roofs and green walls" (132). *The Open Space, Sport and Recreation Study 2004*, updated 2008, suggests greenroofs under provision of open space and this also references DP31 – *Provision of, and improvements to, open space and outdoor sport and recreation facilities*. In addition it references the BAP, so both provision for wildlife and people are considered here:

> Even where no additional open space is being created we will seek other forms of biodiversity such as biodiverse landscaping, habitat creation, green or brown roofs and, where appropriate, green walls. LBZ's Biodiversity Action Plan identifies habitats and species that are particularly important in LBZ. Our LBZ Planning Guidance supplementary document will provide further information on the Council's expectations for improvements in nature conservation (OSSRS 2008:137).

This section's evidence base is *LBZ Open Space, Sport and Recreation Study*; *Open LBZ Space, Sport and Recreation Study Review*; *Open Space Strategy for LBZ 2006-2011*; *Draft LBZ Biodiversity Action Plan 2009*; *LBZ Sustainability Task Force Report on Food, Water, Biodiversity and Open Space* (2008); *The London Plan* (2008); *Connecting with London's nature: The Mayor's Biodiversity Strategy* (2002); *PPS9: Biodiversity and Geologic Conservation* (2005) and *PPG17: Planning for open space, sport and recreation* (2004).

Development Policies

The LDF contains a number of documents which help to flesh out the CS. These include the Development Policies (DPs), of which there are 32, outlining the way the CS is to be delivered; Action Plans which fill in the detail for implementation, the BAP being the most important here and Supplementary Planning Documents (SPDs), which are to give members of the general public insight into how planning applications are considered by the council. DP22: *Promoting Sustainable Design and Construction* details the use of greenroofs for SUDs by elaborating the sustainable development agenda. section 22.8 suggests that flat and pitched roofs be considered, and that this is the case from the initial design stage, not as an add-on. Greenroofs in DP23.7 and DP23.9 are recommended for surface water run-off reduction and the expectation of

> achieving a 'greenfield' rate of run-off. A greenfield run-off rate is one that reflects the natural rate of water run-off from a site before it was developed (DP23.9).

DP24 – *Securing High Quality Design* sets out the expectation for new builds, alterations and extensions that they "should not cause the loss of any existing natural habitats, including in private gardens" and refers back to CS15 on biodiversity.

In terms of providing amenity space:

> Gardens, balconies and roof terraces are greatly valued and can be especially important for families. However, the densely built up nature of the borough means that the provision of private amenity space can be challenging, and the Council will require that the residential amenity of neighbours be preserved, in accordance with policy DP26 - Managing the impact of development on occupiers and neighbours and Core Strategy policy CS5 - Managing the impact of growth and development (DP24.23:96).

The key evidence was provided by: PPS 1 – *Delivering Sustainable Development* (2005); PPS12 – *Local Spatial Planning* (2008); *Making design policy work* (CABE:2005); *The London Plan* (2008), *By Design: Urban Design in the Planning System – Towards Better Practice* (DETR/CABE:2000 and *Building in Context* (CABE/English Heritage:2002).

The Biodiversity Action Plan

BAPs, as discussed in chapter four, are produced at the national, city and local authority levels.[6] The LBZ BAP Partnership, set up in 2002 and supplemented by an audit from the GLA Biodiversity Unit in 2003, identified 36 sites of nature conservation importance within the borough. *The Natural Environment and Rural Communities (NERC) Act* which came into force in 2006 supported this. The current LBZ BAP was reviewed in 2008 and launched in 2010. It contains 'visions and targets' to 2012, and delivery of the plan is lead by the culture and environment directorate, now bypassing the HASC sustainability team. It recognises:

> five species action plans for bats; hedgehog; stag beetle; house sparrow; odanata (dragonflies and damselflies) and seven habitat action plans woodland; grasslands and heath; waterways and wetlands; the built environment; canal-sides and rail-sides; small parks, gardens and city squares; and churchyard and cemeteries (BAP 2010:6).

The BAP vision in relation to the built environment is to enhance the environment, through the private market, developers, building owners and regulated through the planning department. It talks about "installing features beneficial to wildlife" similar to a restoration ecology approach and recognises the built environment as part of human and non-human environments (ibid).

The sustainability team give constant attention to how greenroof projects contribute to the BAP as they are required to defend decisions in relation to annual targets through their reports. The BAP target BE03 is to: "[i]ncrease the number of green roofs by 20 by 2012 (there were 10 by 2010) through the planning process, on council buildings e.g. housing estates" (BAP:2010). The *LBZ Green Action for Change Annual Review* claims that "All the LBZ Biodiversity Action Plan targets have been met or are on track" (2011:9).

LBZ Open Spaces Strategy: 2006-2011

The government places an emphasis on local authorities to commission audits and make appropriate local devisions regarding provision, through *National Planning Policy Guidance (PPG) 17 - Planning for Open Spaces, Sport and Recreation* (ODPM:2002) and

[6] At time of writing, the BAP system is being superseded through changes brought in by *The Localism Act* (chapter nine).

Assessing Needs and Opportunities: A Companion Guide to PPG17, (ODPM:2002). The LBZ Open Spaces Strategy (OSS) written in 2006, marked a change where greenroofs became part of the council's strategy. It links open spaces with health, well-being, quality of life (accessibility, exercise and relaxation) and social and economic regeneration, attractiveness and biodiversity. Success is monitored against Key Performance Indicators (KPIs) within the Action Plan and the Annual Improvement Plans. The OSS refers directly to the Mayor's *Biodiversity Strategy* (2002). 18 strategies and action plans were taken into account when drawing up the OSS document, including the BAP; *LA21 Plan*; *LBZ Open Spaces, Sport and Recreational Facilities Needs Assessment Report. The Environmental Strategy/Report 2002-2005* is one of the most influential sources which discusses the increased demand for allotments, where existing provision is 1.68 hectares and additional need is estimated at 19.33h. Green and brown roofs, roof gardens and derelict sites are proposed to replace these spaces (OSS:5.8).

LBZ Sustainable Design and Construction Policy

Launched in March 2007 and part of the LBZ Core Strategy, the Sustainable Design and Construction Policy (SDCP) aims to promote "high quality, sustainable design and physical works to improve our places and streets and preserve and enhance the unique character of LBZ" (2007:14) and is incorporated into CSP13, CSP14 and CSP17. The CS also references DP22, DP24 and DP26 in connection with the SDCP. The SDCP is framed in terms of the EU and UK targets set for energy and carbon dioxide reduction. These are set out as the 'key legislative drivers' in the *Energy White Paper 2003* which is a long-term strategy for creating a low carbon economy; the UK Climate Change Programme 2006′ which sets out Government policies and priorities for action on climate change, in the UK and internationally; the *EU Directive on the Energy Performance of Buildings* which has led to the introduction of mandatory energy auditing and labelling for buildings and Building Regulation *Part L* which has been amended regularly in recent years to meet the Kyoto commitment with regard to CO_2 emission reductions.

Green Action for Change: The Environmental Sustainability Delivery Plan 2011-2020

This recent The Environmental Sustainability Delivery Plan (ESDP) updates the 2008-2012 version and is both an evaluation of the progress to date and a plan for the coming years. Number 55: "Actions for 2012/12" include: "[i]nstall green roofs where appropriate and where funding is available" (2011:23; 31). Greenroofs are connected here with climate change adaptation (sections 10, 19, 31), carbon savings (part 31), flooding and SUDs (section 9), water conservation (section 10), planning and building control (section 19). This also includes references to the LDF (section 10) and a recorded 65 permissions for greenroofs given through the planning process (section 15).

Planning Policy Statements

The Planning Policy Statement (PPS) landscape is extremely complex not least because LBZ still call theirs as PPGs.[7] PPSs are Government issued to local authorities and the relevant documents for greenroofs are: PPS1 - *Delivering sustainable development*; PPS3 - *Housing*; PPS9 - *Biodiversity and Geological Conservation*; PPS25 - *Development and Flood Risk*; although PPS2 - *Planning and Climate Change* and PPS23 - *Planning and Pollution Control* are also relevant. Greenroofs are encouraged at the design level through planning permissions for footprint replacement from new garden structures (section 6:30:50), for visual aesthetics (section 6.33:50) and as landscaping on buildings. This is supported by section 4.29: Outdoor Amenity Space, of PPG2 - *Housing*, which requires all new dwellings to provide private outdoor amenity space.

In PPG3 - *Sustainability*, the roof really comes into its own as a greened space with inclusion in the energy statement (PPG3:8) to regulate building temperatures and provide "natural cooling." It recommends them in association with siting solar PV for greater panel efficiency, rainwater harvesting, SUDs and insulation. The whole of section 10 (ibid:73-77) gives detailed planning guidance for all new developments which are expected to have green/brown roofs, or defend their reasoning if it is not possible. This mirrors The City of London policy. This section provides technical guidance in the form of roof types, substrate weighting and maintenance. It ends with what LBZ will consider when assessing applications and makes special reference to

[7] PPSs replaced PPGs (nationalarchives.gov.uk/).

PPG15 - *Protecting and Improving Our Parks and Open Spaces and Encouraging Biodiversity* and PPG6 - *Amenity*. Like every other document detailed here, it references *The London Plan*.

Greenroofs are linked in PPG6 - *Amenity* to the urban heat island effect and references PPG3 - *Sustainability and the Open Space, Sport and Recreation Study Update* (2008) which recommends a "flexible approach" be taken to allotment provision with roof gardens supporting the provision (ibid:63). This is backed up by the DPs, which in turn detail and lead into planning decisions. Supplementary Planning Documents, such as planning frameworks, briefs and conservation area appraisal and management strategies are produced for the general public in order to help people navigate the council's planning decisions. All of these strategies, targets, planning documents etc.: "operate together to guide the delivery of the vision" (LBZ CS 2010:14). The self-referential nature of this policy landscape is striking. It seldom refers to policy at the national level, leaving that to The *London Plan*. The work that policy preforms is self-referential and self-validating through recursion. The way this palimpsest, which argues that greenroofs can be used as a footprint replacement strategy will be further explored in chapter nine.

Making Greenroof Policy and the Management of Uncertainty

The first section of the chapter asked the question: what work is policy doing? (Yanow 2011:305) This section asks: what work is policy-making doing? In this context, policy-making simultaneously achieves several things: it is used to formalise practice, as a mainstreaming strategy and is as much a way of governing other teams as it concerns governing the material world. While the LBZ sustainability team worked hard for years to consolidate greenroofing within practice, it was always intended to lead to an internal policy. Davina, the sustainability team manager explained, "so that we can get greenroofs installed as a matter of process rather than as someone has the idea one day that we should do it" (pers. comm.). After reorganisation, the team begin, as discussed in chapter three, to reexamine their work in terms of mainstreaming and job retention. Policy-making, in this case can not be separated from the personal circumstances of the team who find themselves threatened under the co-coalition of Conservative/Liberal Democrat policies of austerity and cutting "middle management waste" (Cameron:2010b). Greenroof

policy-making becomes part of the strategy which officers employ to justify their job retention. The team are able to accomplish this because of an alignment of a number of factors, including the fact that greenroofs have been normal practice and a well known technology within LBZ for a number of years, embedded in the policy palimpsest and the ability to contribute to multiple targets simultaneously. The target of the policy is the formalization of procedures and practices which obligates targeted teams to adopt greenroofing as a requirement.

The existing policies across different themes and departments and are brought together in new formations to craft the conditions for new policy.[8] For this process, two resources become vital: the LBZ shared computer drive and the internet. The shared drive becomes a resource, containing details of past projects, photographs, administration documents and procedures, cabinet and departmental management team (DMT) reports, strategy reporting and briefing notes. The internet becomes a source of new information about research and global policy contexts. This is a mix of creativity and craft; a blend of bureaucratic necessities, structured by forms and formal language but mediated through personal histories of previous attempts at policy recommendation and the exercise of judgement and skill in how circumstances have changed which the team evaluate in an ongoing process.

As an ecologist, Frank's chief personal interest is biodiversity, but he will use any convincing policy and research, at any level, if he believes it fits the context and will have influence in order to instal more greenroofs. The process consists of seven strands which are recursively interwoven as the decision making process unfolds: policies which are always used; policy hot-topics, which change and are related to: funding opportunities; research; other local councils policies and actions and reference to local events. These are all drawn together and mediated by Frank's own expertise, what he judges to be current concerns of the organisation and what he believes will 'get past' (persuade) the senior management.

Meeting

A meeting was held in the LBZ offices in March 2011 at which Gordon (project and liaison officer for the regeneration and development team), Davina (new sustainability team leader), Tom (ex-sustainability team leader), Frank (sustainability officer) and I are present. The focus of the meeting is to introduce Gordon to the benefits and

[8] Jones describes education policy as an "over determined bricolage"(Jones:2001).

technical aspects of greenroofs because he is considered a lynchpin between the sustainability team, the regeneration and development teams and the tenants.[9] Davina believes that, with nine roofs already laid, a further two in progress and one being planned for later in the year, that there are enough examples to argue for formalization through policy with the goal of mainstreaming. She says: "I think its still important to get all this together into a proper study that we can present" to senior management. The roofs, installed as part of their ongoing project work, are classified now by Davina as exemplar projects.

By reframing roofing practice, Davina initiates a process of consolidation whereby practice becomes research. Thus, if successfully presented to the senior management, this will keep greenroofs in practice by placing the burden on other teams, even if the sustainability team is made redundant. Frank is surprised at this downgrading of his work to both research and 'a novel idea'. He characterises greenroofs, not as exemplars but as a cutting edge technology which they have developed into normal working practice. This has involved extensive research into construction, planting, maintenance and costs, keeping up with new developments, going to seminars, trade shows and networking to develop partnerships with numerous people in London and further afield. They have set up and managed a number of research opportunities with local universities. Many of these activities have been carried out at work but many in Frank and Tom's own time because they are committed to the idea of installing greenroofs. This is not, for Frank, novel or 'one off', nor is it research and he is initially upset and puzzled by this.

However, Frank is simultaneously proud of the formalisation and validation of his and the team's hard work. However, this comes with regret that the long term strategy of mainstreaming through policy would give control to other teams and while he could advise on biodiversity and ecology, the impetus and implementation would no longer depend on him. Of course, he also knows that in the long term, the more successful the mainstreaming strategy, the sooner they will be made redundant.

Producing Exemplars

The definition of exemplar is "a person or thing serving as a typical example or appropriate model" which means sample or imitation, originating from Old French *exemplaire* and late Latin *exemplarium* in turn from Latin *exemplum* (OED:2013c). The

[9] One unstated reason is for Davina to construct a team history of greenroofing before Tom leaves.

word example is further defined as "a thing characteristic of its kind or illustrating a general rule" (OED:2013b). Davina's use of the exemplar is similar to Kuhn who describes them as "concrete models of research practice", referring back to Aristotle's technique of rhetoric, where the paradigm and exemplar are used interchangeably (2012:xix). While Kuhn has many uses of exemplars, some meanings are more productive in an attempt to describe how the greenroof exemplar is produced and used in the policy-making process. LBZ's structure of policy-making forms a "disciplinary matrix," a field in which action takes place, bounding and shaping the process (Preston 2008:56). Preston describes them as "concrete problem situations which provide agreement on what constitutes the real problems in that field and on what would constitute their solution" (ibid:39). Following from this, the exemplar is a 'successful theory' (ibid). In this greenroof policy case however, there is one material exemplar but it does not form the "very best and most instructive example" (Kuhn 2012:xix). A number of greenroofs, the characteristics of which are disassembled and recombined to form an imaginary, generalized, template which enters the policy landscape. The exemplar stands finally as having gone through the process of standardization and holds a number of characteristics which they believe will work in a very specific set of conditions within LBZ. It is redefined into the most general, inexpensive and easy to maintain, despite it not delivering adequately on biodiversity and ESS, thus holding several conflicting characteristics in tension. The description of the process that follows will show how all these points are developed as the process unfolds.

The production of the exemplar now involves a restructuring of information and reframing of the materiality in order to see "whether we have enough knowledge of the types of roof we have on at the moment" (Davina). Everything: completed roofs, project details and practical considerations are collapsed into one large reserve of research. Following Lucy Suchman who reinterprets the Kantian ideal, not as a transcendental quality, but as an effect "produced through binding heterogeneous elements together into a tightly coupled, widely extended network" (2000:31, 196), characteristics of individual roofs are drawn out, gathered and sorted. This stabilize multiple meanings, then represents them in a bureaucratic form which becomes intelligible to the organisation, producing evidence for the 'best practice' of greenroofing.

Best practice does not have to be positive evidence as anything negative, failed, redesigned or rebuilt can be presented in terms of 'lessons learned'. This produces one exemplar: imaginary, ideal, homogenous, standardized and applicable for all situations, but equally adaptable and flexible, able to be altered to provide more (or less) of whatever is required. This is not the "very best and most instructive example" of

a greenroof, in the sense that the wider greenroof network would envision it, but the one which represents the easiest and most cost-effective solution for LBZ (Kuhn 2012:xix).

During the meeting, each greenroof is discussed in terms of physical qualities and categorised in terms of its planting and maintenance needs. The variability of greenroofs now becomes a liability for the team and this must be contained and standardised. Several sedum roofs are described as "straightforward", another is "sculptural," yet another is biodiverse and one is a "wildflower" roof, which flowers in June but is slightly pitched and "difficult" (pers. comms.).

The aesthetic qualities of sedum versus wildflower roofs are also considered. Flowers are favoured when roofs are overlooked, however, they require fertiliser and increased watering during dry weather, so they require more maintenance:

> If there is a hosepipe ban, then you shouldn't be watering anyway. If it is there to save on resources and grow naturally, it should not need watering. It goes against the remit if you have to spend resources on it (Davina).

Ongoing maintenance for greenroofs is problematic when funding is increasingly scarce at the local authority level. Some of the older greenroof maintenance contracts were due to expire and Tom suggested the ground maintenance team should formally take over, to avoid being their team becoming burdened with ongoing maintenance costs and labour.

> There hasn't been a budget to date but we do need to get away from taking on responsibility where, in the end, you could end up with five or six, or ten or fifteen roofs … there needs to be a system in place while its early days so that everyone knows what to follow (Davina).

Therefore sedum roofs which require initial annual inspection by external contract and then can be left untouched become the preferred option. Sedum is the least expensive option, is easy to procure and lay and is low maintenance. However, the trade-off is that they are less biodiverse and it seems like this compromise is easily made by Davina who says: "any bit of green is better than a lump of grey".

Where to lay sedum roofs is discussed. Flat roofs are easy to access and install, versus pitched roofs which are not. They declare an 'essential' link between greenroofs and solar PV because they are about to initiate a solar project and may be able to install

some simultaneously. A greenroof keeps the roof surface within optimal temperature requirements for solar panels. This leads into cost/benefit which is discussed extensively and the business case is "financial costs versus life of roof versus traditional roof life" (Davina). This point is given very little consideration. However, at a later time, it becomes the point on which all greenroofs turn at LBZ. Further strength for the business case is provided by a the identification of areas prone to flooding. The management of storm water and prevention of damage to borough properties become a problem they believe they can ameliorate through aligning greenroofs with the SUDs agenda. The team discuss bundling installation with Decent Homes delivery in order to save on scaffolding costs, which can be extensive and also on resident goodwill which can be in short supply.

The council's special status as a public, non-profit organisation with statutory requirements for the long term management of housing stock means that the business case takes on additional concerns. While statutory requirements need to be fulfilled, there is no profit made from installations and works, so the least expensive option is not automatically chosen and this is often done in consultation with resident/leaseholder groups. A range of options can be considered with 'resident benefits' scoring highly in decision-making processes. Greenroofs fit well into this kind of financial thinking. The management of housing stock and greenroofs are both long-term investments, and therefore break-even points calculated in decades versus replacement dates work out favourably. This is strengthened by the multiple benefits greenroofs deliver. The non-pecuniary benefits of improved aesthetics, community engagement and well-being are often given high priority. One roof laid in 2006, the one described by Davina as 'sculptural,' was deliberately designed to be pretty because it was overlooked by residents, even though it was more expensive.

These criteria change over the course of several months as details are drawn out, discussed and refined but generalizations lead to the development of further considerations for trouble-free implementation. For example, the 'essential' link to solar PV is dropped as the solar project running concurrently becomes reserved exclusively for pitched and not flat roofs. The greenroofs are then argued to be valuable in offsetting some of the energy costs for those properties not suitable for solar. This becomes a matter of fairness for those who are unlucky to be housed in north or east facing properties. These kinds of details are aired, discussed, sometimes rejected, sometimes reconsidered and sometimes held until they are accepted as basic necessities and incorporated into documentation such as briefing notes or recommendations sent to senior management and elected councillors. The greenroof exemplar which is pro-

duced is low maintenance, inexpensive and externally funded, situated on flat roofs, in catchment areas and tied into Decent Homes delivery where possible. Ultimately Davina decides despite Frank's wishes for biodiverse roofs, that the straightforward sedum mats should become the working default, concluding "we know what works, we know what the pitfalls are" (Davina).

Managing Uncertainty

The exemplar greenroof, idealised, standardized and positioned in the centre of a policy palimpsest, is now capable of entering and becoming sensible to the bureaucratic systems within LBZ. The exemplar has been reinterpreted as a set of principles, denominators which provide a baseline and a working template or pattern which can productively draw together multiple policy statements. The next step is to develop tactics about how 'to position' the greenroof exemplar in order to have the policy recommendation accepted. There is a lot of uncertainty about whether the process will work and this is not unfounded, as the team has sent numerous greenroof policy recommendations to the senior management over the years; all of which have been rejected.[10] Davina argues:

> I think its still important to get all this together into a proper study that we can present… So that we can get greenroofs installed as a matter of process… and see if we get it passed.

Davina, like the others, thinks it is worth trying "even if its going to be batted back to us." Her comment "at least we've brought it to their attention" is typical of the resignation that decisions are ultimately out of their control, but that they will have done all they can. However, the stakes are still high, as failure to have recommendations accepted could backfire on the team during yearly employee assessments. Davina consults a colleague in another department: "and speaking to colleagues of his and where they've had greenroofs which have gone to LVT[11] they haven't been successful". She is referring to two cases (which the others are familiar with) in which local authorities have been taken to Leasehold Valuation Tribunal (LVT) over the laying of greenroofs. In 2006,[12] 11 leaseholders of Combe Mews, Blackheath brought a case

[10]The siting of solar PV on social housing has been consistently rejected over five years, until early 2011, even though, as they argue, "the business case adds up" (pers. comms.).

[11]Leasehold Valuation Tribunal.

[12]Please note that this represents practice pre-GLA Technical Report in two other local authorities.

against the London Borough of Greenwich and in the same year residents from the Ethelred Estate took the London Borough of Lambeth to LVT. In both cases the leaseholders refused to bear the extra cost of laying a greenroof. The Belbehri v London Borough of Lambeth case summary stated:

> the additional value that it would give had not been proven. Evidence was given as to the increased performance that the roof would give with regard to thermal performance and life expectancy but this was not accepted by the tribunal as independent and the tribunal found against the landlord (Lon/00AY/LSC/2006/0165 Belbehri v London Borough of Lambeth).

Frank believes he understands why the greenroofs failed in the two cases and how they can position the recommendation, to renegotiate the case for policy. His assessment is that the evidence presented in court was by the greenroof company which laid the roof and it amounted to "a sales pitch". It is the presentation of what Frank characterises as "hard evidence" which may change "the status quo." So, he thinks "the game may have changed a bit since then." He suggests that as "all the counsellors have signed up for 20 greenroofs to be delivered … not only through our housing but it is part of the biodiversity action plan," so they should be "on-side" (pers. comm.). Reminding counsellors of these commitments is seen as vital to put pressure on the senior management. Even if the recommendation of greenroofing is made policy, it is still uncertain whether the leaseholders will challenge the decision. However, with their jobs already on the line, it is a calculated decision they are willing to make.

Using Policy to Craft Policy

The next stage is to start to craft a policy recommendation document to present to senior management. The repetition of policy statements and documents over time becomes relied upon, forming a bureaucratic pattern (Riles:2000) which through its repeated appearance in documents, gains credibility and authority. This allows people at all levels to communicate with the same language, from building and regeneration teams who replace damaged roofs to senior management and other decision makers such as elected councillors. The authority of greenroofs grows through this process. These patterns identify and speak to concerns over the governance of targets which describe and quantify the built environment within their jurisdiction. Despite

the plethora of possible policies at multiple levels and in different areas, and used by other councils, in practice a limited number are chosen by the sustainability team to support the practice of greenroofing within LBZ. The next section details the sources, policies, arguments which are examined and used to construct an argument about why greenroofs are necessary for LBZ.

Sources Always Used

The central document in use is *The Technical Report* (GLA:2008). It is the most widely influential document on existing greenroof policy in London. Both the vision of an ecologically sustainable city and a manual for how this greening is to be achieved, the report is cited in every greenroof document (briefing notes, reports, transcripts of meetings and briefings) I came across at LBZ. *The Technical Report* links scales from the global, international, national, and demonstrates their relevance to the local London context. It then informs the London local boroughs, through *The London Plan* (2011), recommending targets to which local frameworks are expected to contribute.

Another document which is used frequently in the office is the CIRCA guide *BUILDING GREENer*[13] (Newton et al.:2007). Frank says this is the book most useful to him and he returns to it repeatedly.[14] It is the first attempt in the UK to publish guidance for green infrastructure across all sectors. The office copy was obtained by attending a CIRCA training course, led by Gedge and Grant, and it is extensively highlighted to indicate useful pieces of information and research. The research reference from Nottingham Trent University (ibid:9) circulates through many documents and emails for example, to a colleague who asks about the energy transfer properties of greenroofs. Frank is always interested in and circulates extensively, what other councils are doing in London, and the book highlights examples of this.

Policy Hot Topics

The London Plan tends to be invoked everywhere, the BAP and LDA frequently and the SDCP and OSS occasionally, where required. The interplay of these five documents form an increasingly recursive institutional pattern which is used to address 'policy hot-topics'. These are defined by funding opportunities. By mid 2013 air quality has become a major concern in London (Duffield:2011) and is supported by GLA funding

[13]This capitalization is correct.

[14]So useful, in fact, that he presented me with a copy when I left LBZ.

to cover innovative schemes to reduce pollutants. However, in 2010-11 the hot topic in London is water management and greenroofs fit easily into this agenda through the Drain London scheme which offers funding for innovative solutions for SUDs. Frank applies for all funding he can, deciding how to use the money after securing it. The multiple greenroof benefits are used in all funding applications and emphasised in varying degrees for their applicability to policy-led concerns over the governance of the borough's environment.

Research

Scientific and bureaucratic documents have different functions. Scientific documents make arguments and bureaucratic documents fix or solidify them into fact, as the information moves from one to the other (Riles:2006). Research is chosen to demonstrate the benefits of each roof, tailored to the document, either a funding or planning application. Frank uses the BUILDING GREENer (Newton et al.:2007 capitals in original) for examples of relevant research.[15] In his search for "hard evidence," he identifies gaps and these include longevity, 'real' (actual, not modelled) data on energy savings, health and psychological benefits. The team discovered a local university research study on a London roof. This investigated potential energy savings through real and modelled results. The headline of £3000 in potential savings due to the insulative effect from the summer sun of up to 6° circulated widely in emails. However, there was no followup assessment so the roof does not need to actually 'prove' money saved, a claim is just as effective. There is no value in assessing already completed work. Research is used to justify action and decision, not to prove project success. Social benefits are argued by association. Frank uses evidence from studies that green spaces are beneficial psychologically and makes the connection explicit. He also tends to offer all new roofs for research opportunities and includes academic research in funding bids and business cases to add veracity.

Other Councils

Although the team regard themselves as leaders in the field of sustainability, Frank considers an important aspect of his work and reputation to be monitoring other authorities, especially those nearby and of similar size to LBZ. The team recognise other's successful strategies and try to emulate them. Lewisham, Camden and Is-

[15] I also become a research resource.

lington and the City of Westminster for example, already have greenroof policies and guidelines in place. The team networks with neighbouring sustainability officers and their projects are always regarded with interest for methodology and innovation, especially for inventive ways of circumventing awkward policies and institutional regulations.

Councils from other cities are monitored through contacts and gossip, through magazines and websites and through contractors and salespersons if they are conducting the same kind of projects. The progress of Leeds City Council was of particular interest during the start of the solar PV project. Details of the way Leeds responded to the legal and risk management processes were systematically gleaned from the sales representative who attended several meetings with the team. This kind of comparison is used repeatedly when reporting up to senior management and councillors with the aim of demonstrating how "far behind other councils we are" and urging them to take action verbally and in reports (numerous pers. comms.).

High Profile Events

A locally famous flooding event in 2006 appears throughout the landscape of documents produced by the team. This not only attracted media attention, but prompted a flurry of complaints from very wealthy residents to the senior management and elected councillors and this quickly filtered through to the sustainability officers. "They wanted to know what we were going to do about the flooding" Frank says. He links this local example to the overall water attenuation capacities of greenroofs and in turn repeats this flooding incident in the hope of reminding the policy-makers on whom the go-ahead for projects and policy rests, by connecting *The Flood and Water Management Act 2010* to this local flood. He positions this as the ability to hit multiple targets and simultaneously, to solve the personal problems of the senior management. Local narratives which are particularly pertinent to the way LBZ works allows Frank to press to advantage any statistical or narrative evidence he finds.

International Policy Landscape

Globally recognised greenroofs are used in a similar way to provide evidence of success in the policy process. The vernacular sod roofs are invoked, to infer legitimacy as an example of how 'normal' and 'natural' greenroofs should be and to support

the longevity claim (Newton et al.:2007). This is often linked to places with a strong policy framework. Contemporary greenroof policies and climate change adaptation from European or American countries are used as a way of describing how "far behind we are in the UK" (pers. comms.). Almost every training, information session or talk I have attended had a reference to international roofs and roof policies. One LBZ briefing note,[16] written to communicate the importance of the implementation of greenroofs starts "[m]odern green roofs took off in Germany during the 1980s with strong government encouragement" and goes on to reference earlier forms of greenroof (n/d but pre:2010).

There is a constant mobilization of comparisons running through the wider greenroof network through education, policy and training. Other cities and countries and their ability to link with the past are invoked through vernacular forms of architecture (Norway), for progressive thinking on water conservation (Portland, Oregon), or for ecological action (Germany). Germany has become a shorthand for this advanced state of climate adaptation, where "43% of cities offer financial incentives for roof greening" including grants for installation and reduction in sewerage charges for greenroofed buildings (English Nature 2003:18). Osmundson (2000) has reviewed German policy on roof greening: of the 193 large cities in Germany, 29 (including, Berlin, Boblingen, Frankfurt, Karlsruhe, Kassel, Leonberg and Stuttgart) give direct financial support to roof greening ranging from €5-€50 (£3-£30) /m2, or between 25-100% of the installation cost. The League of Cities in Germany supports the idea, citing the significant saving in heating and air conditioning costs. Indirect aid for greenroofs is provided in other ways, for example 17% of German cities offer reduced sewage disposal charges for developments with greenroofs. The *Federal Nature Conservation Act* requires mitigation for the ecological impact of building construction and means that greenroofs are often required by conditions attached to construction permits (English Nature:2003).

Germany is often described as a 'world leader' in greenroofs (English Nature:2003; Gedge and Firth:2004). With roofs introduced as early as the 1970s in Germany, they lead the market (ibid) and are leaders in research (Newton, et al.:2007; Rezaei et al.:2005; Wong et al.:2003). The German policy of municipality water run off taxes for greenroofs has become almost mythic. For example, the North Rhine Westphalia municipality offer 50% tax reductions if wastewater is treated according to certain

[16]This is a short document between 2-3 pages which gives relevant information (but not recommendation) to the senior management or to elected councillors on a specific subject. A number of these notes on greenroofs have been produced over the years by members of the sustainability team, past and present.

recognised source control techniques, like greenroofing (Ngan:2004). This is quoted in newspaper articles in the US (Rosenberg:2012) in the UK (GLA 2008; 2010) on environmental blogs (Stutz:2010), in resource manuals for policy makers (Lawlor et al.:2006) and in policy recommendations in numerous cities in Canada, the US, Australia and world-wide (Ngan:2004).

Germany also leads in both numbers and square footage:

> While most cities in the U.S. measure their green roof area in thousands of square feet, Stuttgart can measure its in millions. Some 20 to 25 percent of the city's flat roofs are green and… so are 10 percent of the roofs throughout Germany (Stutz:2010).

Buehler et al. (2011) describe the connection between policy in the German sustainability sector and tax incentives within a larger framework of energy taxation, and argue this has prompted the market to develop innovative solutions for ecological problems. The lessons are argued to be transferable to other countries with the right legislative will. Switzerland greenroof legislation demonstrates how this can be accomplished:

> In Switzerland, federal law requires all federal agencies to apply the 'Swiss Landscape Concept' when commissioning or rehabilitating federal buildings and installations. This means that facilities must be compatible with natural settings and landscape (SAEFL 1998). Laws also require that 25% of all new commercial developments are 'greened' in an attempt to maintain microclimates (English Nature 2003:18).

However, it is the examples of advanced policy-making which have become replicated world wide in policy recommendations. "Cities such as Stuttgart and Copenhagen have begun to mandate green roofs on most new construction" (Stutz:2010). And this success is due to a combination of government incentives, tax abatements, and regulations (ibid). Switzerland, Berlin and Seattle also have mandatory policy requirements. Linz, Tokyo and Vancouver all have planning policy and Beijing has set policy targets. Building regulations are argued to be influential in Chicago, Basel and Vancouver and financial incentives in Linz, Portland, Oregon, Toronto, Cologne, Munster, Berlin and Tokyo (GLA:2008 48-50).

More lately, Seattle and Portland, in the US have become important examples because of their green infrastructure for SUDs agendas. The City of Portland provides home-owners and businesses with incentive grants of $5 per square foot for eco-roofs. Tom Liptan, a storm water specialist in Portland states that:

> It was a cost/benefit evaluation … The issue here was storm water. We were trying to find a way to reduce the burden on the city. If we trap it on the roofs, we don't have to build bigger pipes to carry it or cisterns to store it for treatment (Stutz:2010).

This interview starts: "Long a proven technology in Europe, greenroofs" and goes on: "In Europe, Stuttgart and Copenhagen have begun to mandate green roofs on most new construction" (ibid). Very recently, Philadelphia is being talked about as an inspirational city for SUDs and as the place to emulate. These global roofs are not discussed in terms of planting, design or construction, only in terms of policy frameworks, rebates and incentives, with Europeans and Americans referring to each other in attempts to spur their legislators into action. As such, the roof can mediate between different departments, layers and levels of governance and across geographical spaces and Nation states.

Local Roofs

London governance frameworks are tied to the specific circumstances of the city. The general and global exemplars, ideas, policies and solutions become situated and adapted for localized conditions. Documents which Frank uses are designed to tie together the different scales within London and all bureaucratic levels in this policy landscape lead to the local. Local examples of success, such as The Kensington Roof Gardens are used frequently because this is likely to be the roof most people have heard of, or visited. It was designed by Ralph Hancock on Derry and Toms department store and opened in 1938.[17] It is often used as an example of longevity, however, it fell into disrepair and had to be completely refurbished in the 1980s so the claims are stretched slightly. Other roofs frequently mentioned as authoritative examples are the Komodo Dragon House and Shop (a trial of 45 different greenroof types) at London Zoo, and a private house, The Muse in London, which can be visited during the Open House Scheme and the National Gardens Scheme.

[17] It is now to be found on top of Marks & Spencer and covers 6,000 m² (1.5 acres) including Tudor style, Alhambra and English woodland sections.

The German exemplars have been inspirational within LBZ for some years now. For example, The report, *Food, Water, Biodiversity and Green Spaces* suggests:

> We would like LBZ to lobby the government for the right to introduce water run-off taxes. The money raised could be spent on installing water efficiency devices in buildings across LBZ. If it proves impossible to introduce water run-off taxes, then the alternative would be financial incentives for householders to green hard surfaces under their control. So, for example, we might offer an eco grant for anyone willing to un-pave their front garden, install a porous driveway or fit a green roof (2008).

Targets: Making Officers Up

Documents at the local government level are animated with targets in order to structure, validate and assess them. Frank refers to these targets while linking greenroofs with the documentation described above. Greenroofs are the technology which will solve environmental problems in multiple policy areas and help LBZ as an organisation to meet their targets. Targets are often self-imposed and then reproduced as evidence of progress. For example, *Green Action for Change* states: "65 permissions have been provided for green roofs through the planning process" (2011:15). There is no evidence from LBZ that any of these greenroofs given permissions were ever built and I was told by one respondent (not on the team) that the completed figure was zero.[18] LBZ keeps no record of how many have been built. My attempt to track these permissions through council systems was unsuccessful. It is the permissions which counts as evidence, not the number completed.

Statistics and the way they are presented make it look like policy-makers, through the production of policy, are driving the move to a more sustainable (green, low-carbon) London. However, as has been argued here, practice came first, informed policy and these have assumed a reciprocal relationship. In earlier chapters the constellations of environmental actors worked in earnest for approximately 15 years to ensure the practice is accepted into GLA policy frameworks. Sustainability officers have been working on installing greenroofs since 2004, with the first one reaching completion in 2006; two years before the publication of the GLA's Technical Report. Policy is

[18] LB Islington state that between April 2008 and March 2009 it gave permission for 7,120 m^2 of greenroofs (Islington Council:n/d).

merely one step in the formalisation of that practice. People involved with greenroofs regard themselves as being highly successful within London through policy acceptance. Quantification is another.

Targets are the measure of success and are often scrutinised publicly. Reference to how projects will accomplish targets is seen as a vital part of document preparation. So when Frank writes that the team installed three greenroofs in 2006, two in 2009 and four in 2010, he is referring not only to successful past performance but to process leading into the future in relation to the target of 20 greenroofs by 2015. The target, announced in 2010 was: "to install at least 700 m2 of green roofs per year" (*Corporate Sustainability and Waste Board: HASC Report* 2010:6)

Hacking argues that:

> Statistics has helped determine the form of laws about society and the character of social facts. It engendered concepts and classifications within the human sciences … It may think of itself as providing only information but it is itself part of the technology of power in a modern state (1991:181).

This is not, however, a one-way process, directed by policy-makers and acting upon statistically constructed groups of individuals and social others, regrouping them into communities of concern. Policy-makers are being made-up and regulated as much as an imagined public is being acted upon. Officers and individual departments are held accountable and officers are assessed yearly on their performance to target. In 2012, Frank received a poor assessment because his two major projects for that year, the Norcross Close greenroof project (next chapter) and a large solar PV project both collapsed. Neither of these project failures were his fault, but they were his responsibility as project manager, and he was penalised for this in his annual assessment.

Statistical targeting not only measures success, but acts as evidence. The authors of the greenroof audit for Sheffield[19] also suggest a causal link between policy and greenroof uptake in their city:

> Policy support for green roofs in Sheffield began in 2005 and figures from the audit show that this has up scaled green roof projects within Sheffield. Before 2005 there were only 5 commercial green roofs, during 2005, the year that policy support was first introduced 6 further green roofs were

[19]Who are friends and associates of the London greenroof network.

> developed. By 2007 a further 6 Green Roofs were introduced creating 17 green roof developments across Sheffield. In 2007 the green roof centre launched and since then 31 Green Roofs have been installed giving Sheffield a total of 48 green roofs (The Green Roof Centre:2010).

Another interpretation of the figures shows that the presence of The Green Roof Centre might be the catalyst to greenroof uptake in Sheffield and what the figures do not say, is that the head of this centre Nigel Dunnett, and his colleagues have been working with policy makers in the same way in which the London greenroofers have with their city policy-makers. The transference of the credit to the policy-makers is a calculated and strategic move to ensure formalisation and future cooperation.

Guides, the *Technical Report* and academic papers are mined, like the existing policy palimpsest, for decisive statistical evidence that greenroofs 'preform' well. Once a significant statistic is discovered it is used repeatedly throughout documents and applications. In a rational, research-informed policy landscape the reason they have not been accepted as mainstreamed and policy mandated, the team suggest, is that either there is not a sufficient policy framework or that the senior management require more or better evidence and research. However, neither of this supply a satisfactory explanation.

Firstly, a lack of policy is often cited as the reason there are so few greenroofs, in terms of 'lack of clear direction' or 'lack of standards' (GLA 2008:41). As the chapter demonstrates, there is a clear direction and culture of expectation within a huge array of policy documents. These are backed up by the years of experience and greenroofing practice the team have accumulated. Secondly, there is sufficient evidence for the effectiveness of greenroofs in policy documents. What the team means is that within the reasoning of a supposedly rational policy-making system which uses research-informed arguments, if the recommendations are not accepted, it is because the research is lacking. Frank can identify significant gaps in the research, especially in the areas of longevity in the British context and social/psychological benefits. In addition, the internal political climate of LBZ means that the senior management regard the laying of greenroofs as an issue best enabled through the private sector, and regulated through the planning department. This changed only when the team argued they could mainstream their work through other teams.

Greenroof Recommendations

From the outside, this process of dipping into and using these reports, plans, targets, recommendations, acts and policies looks random, like the pick-and-mix approach Heelas (1996) suggests for the New Age movement. These may seem to be random as they are constantly responding to the management of uncertainty and change, increasing knowledge about processes and institutional conditions within LBZ. It is, however, on deeper appraisal, a careful selection with distinct logics at work. Elements are constantly judged against the probability of success. In many ways, this process relies on the collapse of public and organisational policies into just one policy landscape. At times during the process, it is difficult to tell which is which and in many practical ways it does not matter.

A proposal document, authored in 2008 by Frank, but worked on by others in the team, including Tom sought two things: "[c]ompulsory consideration for all roofs requiring renewal to be replaced with a green roof" and "the compulsory use of green roofs in all new suitable developments" (Energy & Sustainability Unit Green Roof Proposal:1). The cost-effectiveness is highlighted in relation to the roofs lifespan and value to residents.

> cost between 17 and 25% more than a conventional roof. Typically, extensive green roofs can cost 35% more than conventional roofs. They are, however, expected to last at least twice as long as conventional roofs protected by reflective paint or gravel (60 years as opposed to the 30 years expected for single ply roofs) (ibid:6).

The 'high profile' London roofs given as examples of longevity are the modernist Isokon building on Lawn Road, Hampstead (built 1934) and The Kensington Roof Gardens (built 1938). The recommendation also quotes research from 11 sources which are not fully referenced by the team, so the senior management have to take it on trust that this has been done effectively and responsibly. In addition to these, BUILDING GREENer (2007) is quoted several times as is the *Technical Report* (2008). The last reference is to the "Experience of LBX Rorty House" which was quoted in one of Tom's previous greenroof proposals in 2004. The section *Supporting Policy*:

> This report seeks to follow the examples set by a number of Local Authorities (i.e. Sheffield and Ashford), cities (Portland, Toronto, Linz) and countries (Switzerland and Germany) which encourage green roofs in all

> roof replacements and new build … we in the UK could certainly benefit from this forward thinking (LBZ greenroof proposal document:2).

Success here is attributed to the "legislative and financial support" of both state and municipal governments and there is also an appeal to the city level, using: Glasgow, Birmingham, Manchester and Sheffield as well as eight other London boroughs (ibid:2). The national policy drivers are listed as the *Report of the Royal Commission 'The Urban Environment 2007'*; *Planning Policy Statements: PPS3: Housing; PPS25: Development & Flood Risk; PPS9: Biodiversity & Geological Conservation; British Council for Offices* (2003) and *CIRIA's BULIDING GREENer*. These examples change over the years and are tailored to current management concerns, as is the importance given to the benefits. These are: thermal, using figures from a Nottingham University study, which Tom gets from *BULIDING GREENer*; reduction of the urban heat island effect which he links specifically to the local London context; cooling properties of greenroofs which are linked to vulnerable people in terms of hypothermia and heat stroke; delivering national, regional and local BAP targets; SUDs; pollution, in terms of carbon sequestering, removing airborne particulates and heavy metals; reduced maintenance and the increased life of the roof. Other benefits listed, but not given detail include: improved noise reduction; food growing; increasing the efficiency of photovoltaics; as an area for disposal of construction material; protection of roof from UV radiation (in contrast to an albedo, white painted roof); education and increased value of property. In 2008, there is no real evidence that greenroofs will increase property value, only the team's personal view that they will. The report ends with the recommendation that the best time to consider greenroofing is when a roof refurbishment is planned.

The Policy Proposal

The team have regularly produced proposals, briefing documents and proposed policy changes throughout the years, without success. This current recommendation document does not differ greatly from the 2008 version. It is largely produced by 'click and pasting' from older documents. The only real change is that this time, it is accepted. The document is a summary and presentation of the exemplar authored by Frank. Then it 'goes through' Davina to be edited. Frank tries to keep it as short as possible, no more than two to three pages, with an introduction, background, overview of past projects, new evidence, LBZ's current policy and the reasoning behind the proposed change. He includes a short section on the best way to manage and implement

greenroofs in the future and recommends that every time a flat roof is replaced that the possibility of a greenroof be considered as standard. He would like to include a 30 page appendix as there is so much research to add, but he knows this would not be useful.

Frank's expertise is distilled into bullet points and the pattern of repeatedly citing external documents like *The London Plan* and internal documents like the BAP, link policy, targets, and make the information easier to recognise and accept. This process of constructing the document and to having senior decision makers read it can take up to six months. The decision then goes to the Departmental Management Team (DMT), the District Management Team (DMT)[20] and then 'to cabinet' which is the colloquial collective term for the elected councillors who hold portfolios and who vote on major decisions concerning management of the borough and implementation of future policy. They ratify all amendments to policy and planning documents and their meetings are usually public.

The linchpin between the team, whose research and report writing is trusted, and the senior management, who prefer to keep themselves physically and organisationally aloof is Davina. She is the gatekeeper through whom all documents pass. She edits them carefully in order to present the best possible case and to make sure they align with what she believes the senior management want and will accept. The recommendation is supplemented with verbal questioning by senior management and cabinet. Even though Frank is the project manager, holds all the technical knowledge and has written the proposal, it is Davina who defends the document in the meeting.[21] It is noted by the other team members that she has still not seen or visited a greenroof.

The result

By the middle of 2012, the DMC and the DMT agree to recommend that greenroofs be incorporated into a separate, specific and targeted policy so that when a social housing flat roof requires replacement, it is automatically greened, unless it can be demonstrated why one should not be laid. The difference this time is not additional 'hard evidence', but the overall project of mainstreaming which means that projects can be absorbed into other teams, in order to continue to consolidate the reduction in

[20] A committee, composed of tenant representatives and councillors who advise the Cabinet Member for Housing and Council Officers. They set budgets and cover all management and maintenance issues within their district.

[21] This meeting was held long after I completed fieldwork. I heard about it through Frank, with whom I socialise.

staffing levels. In addition, the long term cost/benefit, where the built environment can now solve problems of ongoing maintenance, at little internal cost, changes the stakes. This is validated by the developing organisational culture of acceptance of greenroofs through recursion of practice and policy. Neither Davina nor Frank is contacted directly about the result, but Frank hears of its success at a routine inter-team meeting. This is typical of the way in which information travels through LBZ and he is not surprised by this. He has learned to accept victories as being untied to an individual's career or personality, unlike failures, which are often personally attributed.

Mainstreaming through policy results in the transference of expertise from the sustainability team to both the regeneration team who manage re-roofing and a general maintenance team. Theoretically, the requirements and conditions have been standardized into a sedum mat and the greening procedure becomes routinely considered and installed. Interviewed a year later, after he has begun to work in the private sector, Frank admits he does not believe the policy will have any effect. On one occasion he says:

> The final push over the line did not happen. As the protagonist for this policy responsibility – which did change to an extent, this will only be words unless LBZ's contractors are contractually bound to deliver greenroofs … Without that contract, greenroofs on LBZ social housing will remain a subjective option, when and where external funding can be sourced. In essence - no change (pers. comm.).

And on another he recognises that policy in and of itself is not sufficient:

> I don't think ultimately greenroofs will carry on as they have been for social housing retrofitting. Why? No ecologists in housing - no Franks, Toms or Kofis. Merav might push it, however I fear he will be the fulcrum on which everything - eco, green deal - will rest and thus will be busy elsewhere. Biodiversity resources, which supported greenroofs, are becoming smaller and smaller… Out of sight out of mind… I hope I am wrong (pers. comm.).

Conclusion

This chapter demonstrates three things about policy. Firstly it lays out the recursive nature of the policy landscape, with the Technical Report at its heart. Secondly, it shows how policy formation depends on using these existing policies as tools to make new policy. The agentive capacities of greenroofs offer the affordances of standardising, generalising, exemplifying, digitising and spreading throughout contemporary systems of governance. They collapse and reconnect different constellations of policies, recommendations, frameworks and action plans at different scales within the governance of the built environment in London. Lastly, the chapter shows how policy-making is both political and personal. It consolidates personal uncertainty and risk as much as it consolidates and presents evidence for policy-making. By restructuring practice into research an exemplar greenroof is produced; standardized, homogenized, imaginary and manageable. The material form is now capable of moving through the bureaucratic process, being restructured by it and in the process reshaping the local authorities' attitudes to plants, roofs and ecosystems services. This imaginary roof is capable of producing a rational system of policy recommendation. Although this rationalism is hidden beneath and dependant upon the organisation's agenda, in this case staff reductions and mainstreaming.

9

Ecotopia Delayed

> [It is in the] realm of architecture, however, that modifications in aesthetic production are most dramatically visible, and that their theoretical problems have been most centrally raised and articulated (Jameson 1991:54).

While the last chapter detailed policy-making processes, this chapter details one greenroof project in depth to describe how new working alliances between local authority departments are enabled and how working boundaries between different organisations are realigned by the material formation of a greenroof. Previously, environmental concerns, while at the heart of local and national government (Darier:1999; Luke:1999), they have been embedded within environmental teams, meaning little to other departments. Here, environmental concerns materialised in the greenroof migrate through different departments, realigning with interdisciplinary concerns and enabling new forms of consensus to coalesce round the small sedum plant, reshaping the responses to environmental issues in London.

Norwood Close

By 2008 reports were coming in from residents in a small mixed-tenure social housing block that their flat roof is leaking. Patched repeatedly, it is by early 2011, in such bad

condition, according to the roof condition survey, that the regeneration team consider replacement the only option. The project becomes absorbed into the already programmed Decent Homes[1] works. The survey allows Dave from the regeneration team to calculate the structural loading of the roof and the project costs. The team liaise with Frank, to consider the roof for greening. Frank checks on Google Earth that the roof is flat, not overlooked and shaded and decides that it is an excellent choice.

In March 2011 the contractor's report indicates that the roof is composed of felt, woodwool slabs, mineral wool, plasterboard and gypsum plaster, covered with asphalt (typical for roofs of this kind of building). They propose to re-roof with their own branded system[2] which they claim will reduce the U-value[3] from the existing 0.31 W/m2K to 0.18 W/m2K.[4] This marks a significant insulation gain, and complies with Part L of the current Building Regulations. The report is based on core samples of the roof during the structural/condition survey. This enables assessment of the roof's extant construction and it is carried out each time re-roofing is required. This is undertaken for legal and insurance reasons but also results from the lack of available building or architectural records. Structural beam placement and roof composition have to be assessed each time a roof is resurfaced.

There are no records of the structure or plans of any of the social housing units, despite many being designed and constructed by in-house architects from the 1950s until the 1970s. There is no systematic database of repairs, replacements e.g. boilers or radiators or improvements such as cavity wall insulation and only patchy records of the number of bedrooms in each property. These details have to be reassessed and verified each time there is a problem, resulting in hours of telephone calls with residents who may or may not know details about their property's material history.

Many of the officers have decades of experience both with building and with the council's properties and they know the types of building techniques used in their area and can take 'educated guesses' as to the type of construction techniques and materials used. However, as the hollowing out of experience continues within LBZ,

[1] Decent Homes is a social housing technical standard in Britain. It is based on minimums and was introduced in 2000 and updated in 2006.

[2] Which includes 130mm of Parafoam Ultra insulation.

[3] The U-value is the "measure of heat loss in a building element such as a wall, floor or roof. It can also be referred to as an 'overall heat transfer co-efficient' and measures how well parts of a building transfer heat… The higher the U value the worse the thermal performance of the building envelope. A low U value usually indicates high levels of insulation. They are useful as it is a way of predicting the composite behaviour of an entire building element rather than relying on the properties of individual materials" (Brennan:2013)

[4] Based on the combined method for determining U-values of structures containing repeating thermal bridges.

this too will be outsourced and diminish in the future.

Table 9.1: Timeline for the Norcross Close Greenroof Project

Date	Action	Notes
2008	Reports of roof leaking come in	Roof patched repeatedly
Jan 2011	Decision to replace the whole roof	Made by Regeneration team
Jan 2011	Possibility for greening considered by Frank	He checks on Google
Feb	Structural engineer's report received	Roof declared unsuitable for greening
Feb	Decision is made to reject this report	Non-greening is not an option
Feb	Another report commissioned	Based on the assumption that the greenroof will go ahead
March	Contractor's report received	Costs calculated
March	Frank plans planting scheme	Using a previous greenroof scheme as guide
March	Works are scheduled	No one really believes the deadline
March	Frank applies for funding from Drain London	He is successful
April	Frank produces the business case for the greenroof for LBZ	Roof is shaped to fit the legal and financial language of LBZ
5th June	Meeting of all stakeholders at LBZ office	
23rd June	Site visit to roof	
7th Sept	News comes in that project is cancelled	No one knows why
End Sept	Finally, what had happened becomes clear	

Condition surveys involve boring holes into the roof from the outside surface, photographing and documenting all the layers. There is also a condition survey done from inside one of the houses. As this involves boring two holes in a tenant's ceiling,

it is a disruptive and often unpopular process. In the case of the Norcross Close roof, it was found that whoever laid it eight years ago did "a very poor job" (Condition Survey:2011). The previous stone chipping was not properly removed prior to the new surface being applied and this resulted in a lack of bonding of the new surface to the underlying asphalt. Water penetration then became trapped between the original asphalt and the roofing membrane. There had been no lead flashing applied to the ends of the brick walls and no skirting (apron) applied round the service pipes and these also let in water. Detailed photographs are taken at every stage of this survey and precise details of investigation holes are marked on Google Earth pictures.

Two feasibility studies were carried out. The first, in February 2011, was completed by a structural engineer who found that the roof was not able to support the load of a greenroof system. The survey calculated that strengthening the roof would not be cost effective and would cause too much disruption to the residents. Davina, the sustainability team manager rejected this report and commissioned another feasibility study from the roofing contractor's structural engineer under the assumption that the greenroof would proceed. This study concluded that structural steel support beams could be fitted to hold the weight and they should be installed above the finished roof level to ensure drainage would not be compromised. The height of the greening and the additional steel beams also mean that new windows would be required.

The rejection of the initial report[5] became entwined with the team's overall project of self preservation. They needed to be seen to be effectively delivering policy-led projects with clear outcomes. By linking the project with Decent Homes, officers could align their interests with work already in progress and save money, especially on scaffolding. The additional steel beams cost £18,000 and the new windows £5,000. In order for the roof to be completed, Davina decides to fund this out of their team budget, which is unusual. The total project costs come to just under £121,000 and the greening is calculated at £29,000 for which external funding is sought. This quote is less than Frank expects.

Frank begins planning "an acid grassland roof – if possible – in the same way as we have designed the planting regime for Bentham Heights" (email comm.). Bentham Heights, a project started early in 2010 and completed at the end of 2012, like almost every project, aims for acid grassland habitat and full resident access. In this scheme, a resident's vegetable garden is included in the early plans. As time goes on, the technicalities of roofing, building and funding frequently interject to alter the initial

[5] I saw this process of report rejection and a more amenable re-commissioned one, several times during the year.

planting plans and it almost always becomes clear during the project that a sedum mat is to be laid.

The team do not try to access money internally as they know that internal funding will not be made available for this type of project. The team fund almost all of their projects externally, but as Frank points out it has always been like this for them. He is efficient at writing successful funding proposals and is expert at shaping the projects to the funding streams available. He keeps up-to-date with the latest funding streams, through his extensive network throughout London.[6] Greenroofs are such a flexible technology that they can be matched to numerous funding possibilities.

For the Norwood Close project, the alliances are all focused on water management through Drain London. This is a programme set up by the GLA and funded through DEFRA[7] aiming to investigate ways of mitigating surface water flooding and provide demonstration solutions. It is one section of a wider strategy to manage water supply, demand, rainwater and drainage and waste water in the capital. Motivated by the flooding in 2007 in London (GLA:2010), it is a partnership between the London boroughs, the Environment Agency, Thames Water and Transport for London. Each London borough is now required under *The Flood and Water Management Act* (2010) to produce a Preliminary Flood Risk Assessment and a Flood Risk Management Plan, which will lead to a Surface Water Management Plan for each borough by 2015.[8]

The application process involves elements which are formally and informally managed. Exchanges of paper, deadlines, 'outputs' and 'outcomes' structure the formal elements while networking, emails and telephone calls provide informal support. The application process starts with a standard form available to all applicants to download from the GLA website and fill out electronically. The project, although it provides multiple benefits simultaneously becomes shaped towards water management. Benefits become identified as affordances for residents, the council, the wider area and for Drain London's goals:

> local source control in an area prone to flood risk … provide benefits to

[6] Frank suggests that there is a lot of funding for sustainability and that he would have a hard time *not* getting it. However, this is false modesty. The team have been hugely successful at setting up alliances especially for funding. His success leads him to believe that it is easy, that everyone can do it and he is always surprised if they can not.

[7] DEFRA has suffered budget cuts of £500 million since 2010 (Ando:2014) and this pushes them towards supporting/enabling through competitions and funding rather than direct intervention.

[8] The programme is divided into three tiers. Tier one (Mar 2010 to Sept 2010) is information gathering to establish of standard and a framework for modelling flood risk. Tier two (Aug 2010 to Feb 2011) identifies and models surface water flood risk and produces the Surface Water Management Plan for each borough. Tier three (Nov 2010 to July 2011) involves detailed modelling of high priority flood risk. (GLA:2010; see also www.london.gov.uk/drain-london).

> residents' fuel bills through improved insulation in winter and cooling in Summer; habitat provision designed purposely for maximum benefit to local wildlife, through planting regimes and features; increased roof lifespan, resulting in improved life-cycle costs and Net Present Value of the roof replacement; improved sound insulation for residents in the building … benefits to residents through air/water pollution removal (Funding Bid Application Form:2011).

The request for details of any greenroof strategy or programme is answered with a list of policy documents:

> Green roofs are present in LBZ's Core Strategy and apply specifically within: CS15 – protecting parks and open space and encouraging biodiversity; CS13 – tackling climate change through higher environmental standards; LBZ development policies – DP 22 – promoting sustainable design and construction; DP23 – water; Planning guidance number 3 sustainability (green roofs, brown roofs and green walls chapter & climate change adaptation chapter); LBZ's Biodiversity Action Plan (ibid).

The grant is awarded on the basis that the project is situated in an area vulnerable to surface water flooding and greenroof retrofits were one of the options on the Tier 3 Potential Projects. Norwood Close is at the top of a hill but lies in a catchment area, where water flows downhill when it rains. In addition, the funding bid argues that the project will develop a methodology "beyond standard" in order to increase evidence for policy-making:

The case for installing on 'unsound' buildings is innovative and reflects the condition of the roof itself. Frank also knows that the UEL Greenroof Research Centre is contracted to research all the Drain London funded greenroofs, so he concentrates on how the project provides new research. This kind of proposal reveals Frank's knowledge of the ways ecology, research and policy can come together. He submits the form electronically.

> To demonstrate that heavy substrates can be installed on structurally unsound properties through innovation and out-of-the-box thinking … To build our and the GLA's portfolio of evidence which demonstrates the economic benefits of green roofs (in this case for water) … To approach the design of an acid grassland roof (an extremely threatened habitat in London) utilising local expertise and design (ibid).

The proposal then takes on a less formal life online when emails circulate between LBZ, UEL and the GLA. Frank is already on friendly professional terms with Dean, an environment programme officer for the Drain London programme, who he knows through networking events, emailing mutual contacts and from previous funding applications. This does not affect the overall decision of the application process[9] but shows an ease of communication which makes it easier to discuss the application informally and ask for any clarification via email.

Frank's funding bid is successful at the full cost of the greenroof, £30,000. The works are scheduled for March 2011 with a maximum delay on project delivery estimated to be 6 weeks. The schedule is pinned behind Davina's computer and altered repeatedly during the next few months. It is occasionally printed again, it gets so messy with revisions. Nobody actually believes that work will take place in March, but the fiction of scheduling is maintained outwardly until breaking point. In fact, the project takes until August before realistic estimates can be actualised and a site visit arranged.

Even though all the costs are externally funded, Frank is required to make an internal business case to LBZ before the project can begin and in April he does so. The business case is a cost benefit analysis which allows the greenroof to be conceived of in terms of corporate and personal risk, sustainability, value and insurance. The documents for each stage of the process are available from the LBZ central computer system and all templates come with boxes stating how to fill in the form and the reasoning required for each section. This includes: explain the background to and reasons for this project; clarify why the proposed solution is the best one; explain the financial costs and benefits of the project; clarify how LBZ will benefit from this project overall and provide an outline management framework for the project.

The Norcross roof has the primary goal of the reduction of "building surface water run off in an area deemed at risk to surface water flooding" where LBZ is high on The Environment Agency list of most vulnerable settlements to surface water flooding in England (The Business Case:2). Linking the borough with nationally produced statistics will benefit the application by providing solutions to targets that LBZ and the GLA are required to meet. The other greenroof benefits are aligned with targets and costs: enhancement of local biodiversity, in accordance with LBZ's BAP; cooling and insulating homes; prolonging the life of the roofing membrane; reducing maintenance costs and reducing residents' vulnerability to noise, water and air pollution. The project is shaped externally and internally to fit into the SUDs agenda, funding and policy.

[9] I do not wish to imply that there was any favouritism or impropriety.

The options appraisal is a section of every business case document at LBZ. It reflects the borough's position and special status as a public, non-profit organisation with statutory requirements for the long term management of housing stock. LBZ is not required to generate profit from installations and works, and the least expensive option is not automatically chosen. Greenroofs fit well into this kind of financial thinking. While the long term benefits are calculated in terms of how many years they take to pay-off, non-pecuniary resident benefits score highly in internal project assessment and are often given high priority. For example, city aesthetics, health and wellbeing can be described as value to residents, but are difficult to justify financially. One roof laid in 2006, and described earlier by Davina as 'sculptural' was deliberately designed to be attractive as it was overlooked by residents.

The options appraisal presents three choices. Firstly, "do nothing", which would "impact on residents' lives through increased leakage and structural damage and would also increase maintenance cost" (*The Business Case:4*). This is the unacceptable option. Secondly, replace "like with like", which would result in a status quo, or lastly, take an ambitious, more expensive option to give "added value". Enhanced roof structure and greenroof cost a total £52,300 but mean the life of roof will be extended to approximately 60 years. This last option improves housing stock and decreases ongoing maintenance for extra, but not substantially more, (and externally funded) cost. The cost of the greenroof (£30,000) is stated to:

> offset directly through savings made in maintenance (roof is likely for replacement in 2071) and reduced flood risk; and indirectly through energy savings to residents, improved water and air quality and enhanced biodiversity (ibid).

Officers are used to working and planning long term for housing stock, but there is anxiety over maintenance budgets and this means that while external funding can be made available and shapes a project, long term maintenance budgets are more difficult to find. No one knows how this will effect re-roofing projects in the future, so the idea of extending a 20 year flat roof to over 60 years is an attractive idea. In addition, while the indirect benefits are largely non-pecuniary (at least for the council, and at least for the moment) they also coincide with resident benefit and that enables officers to place extra weight on these considerations for project management.

Internal Alliances

Star and Griesemer (1989) might recognise the greenroof as a boundary object: "objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star and Griesmer:1989:393). They describe how objects may acquire "different meanings in different social worlds" but they allow knowledge to pass across and between departments and teams (ibid:393). This next section details exactly how greenroofs act as boundary objects within LBZ, connecting communities of practice (Wenger:1999) with very different professional concerns, knowledges and priorities, allowing them to solve problems using the form of the greenroof. Disciplinary boundaries are both maintained, as Wenger suggests and reconfigured, as the greenroof moves across boundaries, realigning working practices through collaboration.

The intrepreneurial sustainability team spent years working to build consensus with others who often have no interest in sustainability or environmentalism. Many officers are resistant to sustainability projects, regarding them as extra work. However, some officers have been persuaded by the benefits of greenroofs. Joe who is Head of Service Delivery is unimpressed by most of the claims of the team. Even when presented with research evidence he is hard to convince. However, when he is finally persuaded that a project will benefit residents, he goes all out to make sure the project works. For Joe, projects have to deliver demonstrable benefit to residents: this is his bottom line and projects he signs off on either pass or fail on this point. Once Frank has put the business case together for "our own investment" for Norcross Close, Joe consents.

Frank has built up a professional relationship with Paul, a structural surveyor with LBZ who oversees regeneration projects. Paul keeps him appraised on his team's reroofing projects. Again, hard to impress, Paul is not interested in claims of increased biodiversity, hydrology or even sustainability. In meetings we sit together, and he turns to me occasionally when plants and biodiversity are mentioned rolling his eyes, conspiratorially. However, he has been swayed by the evidence Frank has presented him over the years. The extended life of the roof is just too hard to resist when ongoing maintenance costs are spiralling despite ever-decreasing budgets. Where external funding applications and the management of the technical part of the greening are undertaken by the experienced sustainability team, this means no extra work for Paul. It also entails no extra burden on his budget but represents a lifetime savings where 'his' flat roofs benefit from an extended life and a reduction in ongoing maintenance.

Frank often refers to this extended life as "the trump card".

Another important alliance which the team take care to foster is with Gordon, from the estate regeneration team. Gordon's role as consultation officer is regarded as vital because he meets with residents. If he positions greenroofs favourably, residents will accept the technology more readily. Gordon starts to be invited to the occasional greenroof planning meeting in order to "get him up to speed" (Davina). Another key ally in the movement of greenroofs through the council is Pádraig who is a technical sustainability manager with the environment directorate sustainability team. He worked in the planning department before being recruited to sustainability and his expertise in both areas is an invaluable asset for the team. Greenroofs often interface with planning regulations especially as LBZ has a number of conservation areas and listed buildings within the borough. A quick phone call to Pádraig can clear up many issues with timing or planning applications. Even internal applications can take many weeks and be held up by seemingly minor technicalities. Officers treat these with caution and care and almost always consult colleagues in different departments, balancing what they are told with experience from previous builds.

A concern over planning permission was raised about the Norwood Close greenroof. Would it constitute a material alteration to a building in a conservation area? The manager of the conservation and urban design team who was consulted, indicated that for her part, the roof did not need conservation area consent but might need planning permission, although she could not comment authoritatively on this. She recommended that information should be sought from the duty planners. Planning permission was required and was granted smoothly as there was no impact on neighbouring properties or the wider conservation area. Pádraig smoothed the process along and helped to estimate time scales, for planning and funding applications.

Underlying and strengthening these alliances is The Sustainability Task Force, set up in 2006 and comprised of an all-party group of councillors concerned about climate change. It is not formally constituted as a committee of the council but never-the-less is supported by the Leader of the Council and acts as a think-tank and make substantive recommendations to the Executive in order "to put sustainability at the heart of everything the Council does" (2008:1). Its advisory capacity links: "council departments, the local community and experts … It is focused on practical and achievable measures whilst remaining visionary" (ibid:74).

The task force's fourth report, *Food, Water, Biodiversity and Green Spaces* (2008) was prepared by the head of the culture and environment directorate's sustainability team. Several recommendations were made: "the Executive ask officers to install exemplar

green roofs on some of LBZ's civic buildings with public access allowed at certain times" and another suggested that an audit of all properties in the south of the borough both public and private, be carried out to estimate greenroofing potential. The team replied by detailing action already taken and commenting on the feasibility of proposals. For example, an extensive survey would be too expensive to carry out and should only be done on council owned property on a case by case basis. They often saw these kinds of recommendations as unworkable and replying to them as a waste of time. They had already thought about and assessed these recommendations so viewed them as intrusive and unnecessary. For instance, their recommendation that "green roofs will, though be considered as part of housing regeneration projects" was something they had already been working on for years (ibid). However, the task force worked across council departments and at different levels which the officers had no direct access to. Many of their recommendations informed, influenced and consolidated the wider council strategy on sustainability through the *Climate Change & Environmental Sustainability Delivery Plan for LBZ*.

External Alliances: Money, Rains and Drains

By June, a loose alliance of 16 people (including myself) are involved with the project. We are regularly emailed with details, although not everyone takes an active role. Five people from the environment and culture (corporate) sustainability team never attend meetings or get involved in the project.[10] All the internal and external stakeholders (excluding householders) attend a planning meeting in June 2011. The meeting draws together the alignments (Rose and Miller:2010) which form temporarily between LBZ and different organisations each with their own stake in this one greenroof.

People internal to LBZ invited:

- Frank: sustainability officer in charge of the project
- Davina: sustainability team manager
- Paul: programme manager and structural surveyor
- Aamil: project manager (employed by LBZ but works from the contractor's office)

[10]The HASC sustainability team routinely keep the corporate team informed and invite them to meetings. They almost never respond or attend and this courtesy is seldom reciprocated. This is part of the ongoing internal dynamics and the agenda of sustainability at LBZ. It does not, in this case, affect the project.

- Me: research
- Five members of the corporate sustainability team (they do not attend)

External to LBZ are:

- Dean T: environment programme officer for Drain London
- Wendy and Stan: research staff from UEL (Wendy does not attend)
- Peter: represents the contractor
- Lenny: the sales representative
- George: a senior representative from Thames Water

At the meeting it is clear that everyone is fully supportive of the project and has an agenda for and about the greenroof. The recent controversy over the so-called 'super sewer' has drawn attention to the issue of SUDs and water management in London. The super-sewer is intended to link a number of smaller sewer overflow pipes along the Thames which, when it rains heavily, release drain overflow and sewerage into the river. Preventing sewerage pouring into the river on such occasions, and in the long term, as London's population expands, it is now a central concern. The tunnel will be 32km long and construction will take upwards of seven years. Meanwhile, the search is on for alternative solutions to slow down water flow in London and successful ideas are being funded by Drain London.

Some have suggested the Super Sewer puts "trees before people" (BBC news:2011b) while others claim the sewer is not necessary at all (BBC news:2011a). London's changing rainfall patterns are causing more pluvial flooding[11] which puts the Victorian drainage system under pressure. Schemes such as this Drain London funding competition, demonstrate a more distributed, decentralised response to the problem (Bell:2013). Greenroofs help to alleviate the strain on the sewerage system by attenuating storm water and releasing it slowly. They also represent a shift from centralised responsibility to the private sector.

Dean represents the GLA as the fund provider for the Drain London programme and is a respondent I already knew from circulating within greenroof networks. He believes it is vitally important to conduct the scientific research to find out how effective

[11] Pluvial flooding occurs when there is so much rain that the drainage system is overwhelmed.

the greenroofs are for flood mitigation. Frank has also met Dean previously at networking events and he is the person to whom the application form was sent. Dean is working closely with George, the Thames Water representative who is the chief partner in the Drain London programme. His concern is the movement of surface water through the city and the development of SUDs. This partnership is strengthened by the inclusion of Wendy and Stan from UEL who have been contracted to carry out the research on all the Drain London projects in order to assess their effectiveness. The roof has been classed as a water retaining roof for just this purpose. Frank likes the hydrological aspect of the project. It "give[s] us more evidence to show that greenroofs are great things to do".

Paul as discussed earlier is intrigued by the possibilities of the extended life of the roof and for him this is the only thing that matters. Also present is Peter who represents Berkeley Services Group, one of LBZ's preferred contractors and he has experience in fitting greenroofs. Lenny is the greenroof system manufacturer's sales person and he is selling "added value" to the traditional roofing surface. He arrives 10 minutes late bearing a large 3ft x 2ft box containing a cross section of a growing greenroof. This is an advertising and demonstration device which is often used at sales meetings and trade shows. He attempts to place it in the centre of the table and is told to put it on the side. Everyone ignores it during the meeting as they are extremely experienced with greenroofs and do not need to see or 'be sold' one.

The meeting centres round the practicalities and everyone shares their requirements for the project. Much of the discussion is about the time scales involved and in particular round the planning application process which is estimated to take about 8-10 weeks. Peter's team of contractors will have to undergo Criminal Records Bureau (CRB) checks as there are two schools nearby.[12] Other health and safety considerations include man-anchor posts, handrails, insurance for the membranes and hydrology researchers being restricted to one side of the roof for their own safety. The scientific equipment Wendy needs is discussed. We discuss details of where these are to be placed, how they affect the build, how she will gain access on an ongoing basis without disrupting householders and whether equipment can eventually be removed without causing problems at the end of the research. Many of the details of the research materials and equipment are negotiable such as the roof's water outlet piping. Peter indicates they can: "value engineer to accommodate your needs," and there is general relief at the news that all the expensive and complicated equipment

[12]Lenny, who is still grumpy that no one wanted to see his greenroof demonstration box verbally attacks Paul who wants the CRB certificates for all his workers in place before work begins. Paul, and others, are surprised at this lack of professionalism.

will be funded through UEL.

Everything seems to be relatively negotiable and flexible among these building and material professionals. Nothing at this stage presents a sticking point until the residents are discussed. What becomes clear now is that officers do not want residents to use any council roof. As the windows need to be replaced ("do they open them for ventilation?" Davina asks), she and Paul would like to fix the new windows shut. These details need to be worked out in anticipation of the planning meeting in a week's time. Estimates indicate that the planning application will require at least 8-10 weeks, re-decking 5-6 weeks, fitting steel beams 6-9 weeks, so the work should start in October. This entails clearing the resident's car park at the frount of the building and leaving the scaffolding up over Christmas, something they know the residents will dislike.[13] Norcross Close is hidden behind a row of shops and the scaffolding is to be erected at the back of the properties, so the general consensus is that it should not be a security risk for residents. A site visit is organised in order to inspect the roof because no one except Paul has visited the site.

On-site Visit

Norcross Close is a small social housing block consisting of flats, just below street level and accessed by three steps at the front of the property. At the back, they have modest gardens. On top of these flats are maisonettes; two story houses, accessed by a steep flight of steps from the front. Most of the houses and flats have neat fronts with flowers in tubs and pots. The visit is scheduled for an early morning and, carrying a pair of steel toe boots, high visibility vest and hard hat, I proceed to the site. Harry and William, from the contracting company scheduled to replace the roof are already there and Aamil, who works with the contractor arrives. Pauline, the contractor's resident liaison officer (RLO) was already at work, trying to gain access to the roof via one of the properties. This proves difficult and we stand about for some time until one household agrees to let us in. Meanwhile, we wait for Frank and Wendy, neither of whom turn up. When I telephone them and pass on the news that they are not coming, their absence is not appreciated by the other members of the group.

As we wait to gain access, an angry resident comes to speak to us. He had had a

[13] Scaffolding is often seen as an invitation to local kids to climb onto the roof, do damage to property or as a means to access flats/houses to burgle them. I encountered this repeatedly. Social housing tenants complain that calls to the police are often ignored because they come from 'estates'. Contractors often erect wire mesh security cages over the balconies of flats and are frequently asked by residents to leave these up when they go.

letter from the contractors asking everyone to clear their back gardens to prepare for scaffolding. The letter indicates that someone from LBZ was to call the previous day but they did not. He suggested that instead of wasting money on a greenroof, LBZ should replace the windows. The plan is to do so, but Aamil could not tell him this. He, like other officers, can not confirm these kind of details: "just in case it doesn't happen then the 'you said' accusation comes back to me". Pauline calmed him down, and she also eventually managed to arrange access through one of the maisonettes.

We put on our 'plastic shoes'[14] to go inside, taking care not to look too hard at the interior of the house in order to remain detached, non-judgmental and professional. A ladder is placed under the window access at the top of the stairwell. It is high and if anyone falls they will tumble down approximately 12 feet of ladder and probably also down the stairwell to the ground floor. We climb up and out, one by one. The roof is flat and pipes from a communal heating system run along the back section. A drainage trough runs just in front of the heating pipes and it is full of moss at one end where it near to trees. This back section of the roof has a single railing (photograph 5). There are no railings at the front and sides and the lip of the roof is only seven-eight inches high. At one end there is a row of chimneys. On one side of the building there is a primary school with an amalgamation of buildings including portacabins. On the other side stands a Victorian built secondary school with giant chess pieces in the yard.

Walking over the roof's surface, it is clear where the asphalt has lifted off the underlying surface, because we walk over air pockets. Standing pools of water near the windows and the patched areas also indicate where other problems lie. Walking along the roof is particularly dangerous as there are multiple trip hazards like pipes and cables. We joke about the "universal nature of flat roofs: there is always a football" (pers. comm.). On this roof there are three. In the corner also lies an empty champagne bottle and there are some comments and laughter about this too. While William, Harry and Aamil take measurements and photographs, I walk the roof and interview the residents. Then we exit through the house thanking the owners profusely.

In between this visit in June, and the middle of September, things go quiet. Pauline's job now is to visit everyone, let them know about the project and answer any questions they may have about the works or the greenroof. In addition she will make a profile of each residence and the occupants. She agrees to my accompanying her but has to cancel these visits as no one will talk to her. Then, on 7th September Frank hears that the project had been cancelled. For two weeks it is unclear what has hap-

[14] Thin blue plastic over-the-shoe-bags which protect the householders carpets from any outside dirt.

pened. Officers go through clearly identifiable stages during this time. Firstly, they are surprised. The announcement was totally unexpected. Then there was general uncertainty about whether the project had actually failed. This was a typical email response: "think it's hit a few stumbling blocks so I'm not totally sure – you're better off asking Frank! Cheers, Dean." And another, more formal email:

> Any developments on the green roof front? I spoke to Wendy from UEL today and did mention there was a little uncertainty regarding the project but would keep her informed (email comm.).

On a personal and methodological level, people did not want to discuss it initially, because they had no details and were unwilling to speculate. As for Frank, the person who had worked hardest of all on the project, he was disappointed as he had spent a good deal of time and effort getting the funding and all the stakeholders in place. But, again, neither he nor Davina knew why the project had collapsed. None of the participants was willing to find out exactly what had happened.

Next there was a period of speculation. First people wondered if the failure was due to the structural survey which declared the roof unsafe for greening. Frank then suggested that some residents were working behind the scenes convincing everyone not to allow it to go ahead. Speculation was followed by blame. Initially outside causes were sought, like the residents or the roof. Next everyone started to look at themselves and quietly wondered if their actions had been at fault. Some still refused to speculate, others were freer with their opinions. Pauline the RLO, did not know at this stage why the project failed. She blamed herself as she had been "the front line" with residents (pers. comm.). Then Frank suggested, "we didn't have all our ducks in a row" meaning that the evidence and convincing argument about greenroofs was not given to residents. However, this was not exactly the right explanation either, as the project was halted before the stakeholder consultation stage.

People went from blaming themselves to wondering about others. Frank wondered if, because some of the others had not initially wanted the greenroof, they may not have pushed too hard for it. At one point Davina announced it must be my fault for going down to the site and talking to residents. I had clearly riled them up into rejecting the project. While I was surprised by this public[15] suggestion, Frank openly laughed at

[15]Given the atmosphere of blame, I fully expected to be in the firing line, simply because I was the only one of the sustainability team who had spoken to residents. However, I was also expecting to be asked what had happened first and in private, before being blamed!

it and rejected the accusation as "just ridiculous". Much like Mosse's (2011) respondents, Davina felt threatened by my research because of the team's messy and risky position. She was attempting to contain this through processes of professionalism which my presence and writing could destabilise.[16]

This unhappy and worried atmosphere lingered in the office until it became known that the leaseholders had refused to bear the extra cost of the greenroof because of concerns about previous work undertaken on the building. Once this was clear there was another distinct process which was able to start. The potentially harmful effects of failure were distanced from individuals by the maintenance of silence and a concentration on other projects. Over time, a narrative was developed which contained and explained the perceived failure. Like Bruno Latour's oral history (1996) of the Paris travel system which was never built, it shows what may be at stake for individual careers in failed projects.

Architectural projects are "[s]imultaneously technical and social" as Yaneva points out, although officers seldom think of themselves as part of the social (2012:5). Resident/tenant groups are almost always 'the social' and interaction with them has to be managed carefully. Officers often anticipate the consultation process to be problematic; a point where they have to 'manage resident expectation'. One officer indicated any project: "requires a consultation process which quite frankly they were all scared of. Scary leaseholders" (anonymous:2011). It becomes vital for projects to anticipate resident reactions. The greenroof became framed within the knowledge that 'everyone understood' that going out to consultation was the most critical stage. A project which is brought to the consultation stage and where residents disagree with the proposed project means a project can derail but the officers can blame residents directly. However, the greenroof did not get to the consultation stage, so was open to the charge of officer (or researcher) incompetence and mishandling. Frank's main and lasting concern is about the effect this will have on his reputation to manage a project to completion, particularly from Dean at Drain London and others at the GLA. However, as emails and a conversation between Dean and myself reveal, it is clear that no one blames Frank. Dean knows that projects fail all the time and the funding will be kept until another suitable roof is found.

[16]This is the reason the thesis is not about the meaning of 'failure' – despite witnessing the two major projects I was following during fieldwork fail.

Failure/delay

Programmes can take extended periods of time to plan, fund and execute. Officers are accustomed to delays, setbacks and failures. For example, Frank and Tom have worked on a solar PV project for five years prior to 2012, installing the technology on eco-houses and small estate properties in the borough. However, they have been unable to persuade the senior management that a major PV installation programme should be implemented despite the attractive feed-in-tarrifs offered. Projects which involve new or council-untested technologies, multiple partners, long and complex time scales have numerous points where they can fall apart, halt temporarily or require significant renegotiation.

Council systems have a well developed capacity for absorbing projects which do not succeed, or which more accurately, do not succeed at the first attempt. This can be attributed to the longevity councils enjoy as organisations and to the process of long term management of large housing stocks. Long timescales are quite common for projects which can easily be envisioned as being in place for decades. This is one of the problems of talking about failure personally, methodologically and theoretically. By focusing on things that stalled, for legitimate reasons, attention is diverted from the fact that most projects are successfully completed. Greenroofs have been successful within LBZ and while this is dependent upon many factors, in this case resident goodwill and the unwillingness to pay extra for the roof was lacking.

Ducks in a Row: Managing Resident Expectation

As Margery Wolf discovered, by detailing the way a woman fails to be accepted as a shaman, examining the reasons for failure can illuminate how things are expected to work. *A Thrice Told Tale* (1992) is a rare anthropological study of failure, although it is hardly ever discussed in these terms.[17] Why did the greenroof project fail? Firstly, it did not fail because of the plants or the greenroof technology directly. Nor did it fail because any of the officers did anything wrong, or because I spoke to the residents. As time went on it became clear that the leaseholders of Norcross Close had refused to bear the extra cost of the greenroof. The residents, leaseholders and council tenants had a long and extensive list of complaints against the council which they wanted to

[17]The book is usually discussed in terms of its feminist approach, its critique of postmodernism, its ethnographic content or the way it lays out a methodology for turning fieldwork notes into both a short story and also a full ethnographic text.

be taken seriously, but which had been ignored for a number of years. They were angry.

One leaseholder who did not have any leaks above his property questioned whether it was fair that the whole roof was to be replaced. Another resident, referring to the way she felt the leaking roof had been dealt with, questioned the wisdom of "doing something *expensive and fancy* when they could not even get the basic maintenance stuff right" (pers. comm.). This was a repeated complaint throughout fieldwork, in many contexts. It took the form of contrasting innovative sustainability or improvement projects against regular and statutory services such as tree maintenance or rubbish collection. In addition, the comment referred to the recent Decent Homes contract. This was poorly executed, by unanimous officer and resident consensus, throughout the borough. The preferred contractors who had undertaken the work felt they had to substantially underbid their nearest rival for a subsequent contract, which they secured despite resident and officer objections.[18] The council officers could not legally or reasonably refuse the bid, however, and the contractors have since changed their company name.

One leaseholder did not see why he had to pay again if the roof had only gone down eight years ago. He and other leaseholders were still paying for that roof works, "and now another one" (pers. comm.). The structural survey had indicated poor initial workmanship yet the council did not pursue the previous roofers for replacement or compensation. Legal action would be costly and the roof replacement delayed. In addition, there is a complicated legal and structural relationship with preferred contractors which means that the choice is often between two or three companies who have submitted to an application process.[19] The roof survey was carried out by the surveyor of one of these preferred contractors and the other major company had done the work. Officers at LBZ are often in the position of mediating between these companies as they blame each other for poor workmanship. It is therefore in the interest of smooth running of projects to ignore shoddy workmanship from one company or another and just patch up or replace the damaged work. Only in extreme cases are companies taken to court for damages. This, however, leaves leaseholders

[18]There was extensive and widespread complaints about poor workmanship, fitting the wrong appliances, or the right appliances in the wrong places and most of all rude, disrespectful workmen. For instance, one workman thought that shouting in a profoundly deaf woman's face constituted effective communication.

[19]For one project, the application process required the demonstration of a minimum annual turnover, proof of previous work with social housing tenants, health and safety requirements, risk management, the ability to recruit a large number of teams at short notice as well as expertise and experience in the work. In reality at LBZ there are only a very few companies who regularly take these major contracts.

liable to pay their share of the costs with no recourse to obtaining compensation or having the work corrected free of charge.

For one other leaseholder and his family the most annoying and ongoing problem was the noise of the heating pipes which are free standing on the roof. The noise travels down the building and into the back bedroom beside the bathroom, where the children sleep. It "sounds like a ferry" (pers. comm.). His partner rang the council about this many times. Someone from the office "came out to look and then said they would get back to us but we have heard nothing since" (pers. comm.). Nobody has done anything. The problem with this kind of complaint is twofold for officers. Firstly, and unfortunately for officers like Aamil, who hear these complaints in person, they are held responsible for other's work and are not usually in a position to fix the problem. They can only redirect the complaint to the appropriate team. In addition they are not able to confirm work to be undertaken until it is officially scheduled. So everyone on the roof knew that the pipes were scheduled to be boxed in, to reduce the noise, but no one was in a position to confirm this. The leaseholder felt that LBZ was asking him to pay unreasonably, without taking his complaints into account. Had Aamil been able to confirm the intended work, the greenroof may have gone ahead.

Frank wanted to involve residents early in the project as he thought they might be interested in the greening, but at the same time Davina wanted to "recover as much as possible from leaseholders" for the cost of the greenroof. I asked Frank: "if the greenroof is fully funded by Drain London, why are the leaseholders liable for their portion of the cost?" Frank indicated that money was not his department so he just left it to 'financials' and gave me their email. Donna replied:

> Leaseholders'… are required to contribute towards their share of the repair and maintenance work carried out to their building. A leaseholder's individual share of the total building work cost is calculated under the terms of their lease, but it is linked to floor area.
>
> In recharging leaseholders for any works LBZ must comply with section 20 of the Landlord and Tenant Act 1985 (as amended by s151 of the Commonhold and Leasehold Reform Act 2002). The Act states that all costs must be fair and reasonable.
>
> If LBZ opts to replace a roof with a green roof, rather than a conventional roof, and that option is more expensive, then it can be argued that this is not fair or reasonable.

> As a Local Authority LBZ are eligible for many grants and funding options. However, *just because a leaseholders' landlord is a local authority does not mean that they have an automatic right to benefit from these grants or funding.* However, with these types of funding options they really need to be investigated on an individual basis so it's impossible to advise of a general approach (Donna:email, my emphasis).

While the freehold is managed by the council, the introduction of 'the right to buy' council property has resulted in mixed tenure ownership of council tenants, leaseholder residents who own their property and residents who rent from leaseholders. The leaseholders do not: "have an automatic right to benefit from these grants or funding" so effectively, leaseholders could be charged for something which is already paid for (ibid). This does not mean that the team will spend the additional revenue on the greenroof, but that any monies collected for the greening goes into the general authority finances (and not to the sustainability team). The leaseholders did not realise this roof was fully externally funded because this kind of detail was not made available to them. However, they did object to paying twice for their roof *and* the added cost of the greening.

With regard to the legal status of the roof, the council owns it and does not require tenants or leaseholder's permission to site anything on the space. However, at the same time they rely heavily on resident goodwill and dare not site anything without adequate consultation. Residents, often characterised as the 'soft' or 'social' aspect of a project, are regarded as the most variable and least controllable for them. Residents are seen as having to be acted upon, passive, in terms of risk and benefit but simultaneously, as demanding, ungrateful and troublesome.

Leaseholders are regarded in one sense as all powerful because of their ability to derail a project quickly and effectively just by refusing to pay the cost, as this case illustrates. It is impossible to manage a project to completion by holding resident information sessions too early because residents wish to know technical, costing and timing details which may not have been worked out by that stage. In addition, if the project later collapses for any reason, then consultation not only has been a waste of time, but resident expectations have been raised and promises broken. This is a delicate balancing act, and a phrase Frank uses repeatedly is "getting our ducks in a row." This means managing a project to just the right point, i.e. just before hiring contractors when all the details have been worked through. The stakes are high by this point, with months of work for both officers and contractors. If all the information

is not gathered and a convincingly crafted presentation made to the residents, especially the leaseholders who will be asked to bear some of the cost, the project could fail. This process of leaseholder agreement is handled very delicately and is a source of anxiety to officers. In this case, however, the residents anticipated and preempted the consultation process by contacting the council directly and refusing the extra cost of the greenroof.

Agentive Actors and Materials

The greenroof, as an effective configuration of different materials and processes enters into and engages with council systems before becoming materialised in particular ways. Firstly, greenroofs appear in a digital register, standardized into a product which demonstrates affordances described as benefits, shaped to meet the requirements of funding streams. In this case it was control of storm water within a SUDs agenda, in other cases it is biodiversity. The materiality of a greenroof is so versatile that the same roof can be entered into multiple funding streams and argued to do different things in order to become financed. Frank is as happy arguing for greenroofs for SUDs as for energy savings, although his main personal concern is biodiversity.

The project is predominantly managed online; formed electronically through funding applications and internal business cases, emails and search engines (Bing primarily and sometimes Google) and internet sites such as Google Earth. These, as Annalise Riles (2006) discusses, form the aesthetics of modern bureaucratic practices. Documents hold knowledge in particular forms, and in turn shape future knowledge. These are saved in a shared computer drive and accessible to all members of the team. They enable 'copy and paste' from previous funding forms to the current ones and enable a bureaucratic pattern to emerge through continuity of form, especially if a funding bid has proved successful. This process often involves members of the team giving advice and becoming a resource themselves especially if they have completed this process before. They advise each other on wording, spelling, location of documents and photographs, how to use computer programmes and databases and who to contact in the wider organisation for further information or advice, demonstrating the ability to think and act as a cultural native (Frake:1964). Riles (2006) describes the inevitability of encountering documents during fieldwork, and everything, from previous funding applications, permissions and planning, to drafted and completed letters, policy statements, pdfs, plans, reports, photographs all form an archive of past work and projects. These were used as a resource to support current and future

applications.

These documents, mined for useful information and assembled into current applications become a way of envisioning roofs. Roofs are made visible both from ground level and from the air, through Google Earth. This view from above is used for a building's initial assessment. This is achieved in the office as officers do not have the time to carry out site visits at this stage. Officers do not have time to leave the office and visit roofs personally. Nor do they have the ability to access many roofs, as some of them are only accessible through resident's houses or via ladders or scaffolding. In addition, it would not be appropriate to arrange for a site visit so early on in a project. The roof's geographic location, especially in relation to the other buildings in the area, can be assessed. The height of the building, whether it is overlooked by trees which could hinder the roofing and laying process, whether the roof is flat or has roof furniture are all easily, comfortably and cheaply assessed. Roofs can be surprisingly crowded places, with roof furniture including: fans; ventilation ducts; skylights; air conditioning units; satellite dishes; cables; heating pipes (Norcross Close); sheds; spare equipment stored by building managers and weather stations. Equally, other roofs remain completely abandoned and empty.

Officers are able to identify possible roofs, check them quickly and take screen shots for reference and inclusion in reports and proposals. Roof area is quantified by using the lasso tool in maGIC software. The lasso surrounds the roof, then one click calculates the area. Frank spent a good deal of time with maGIC working out the surface area of suitable looking roofs.[20] At this stage, plants are rarely considered except for the general vision Frank has for the ecotopian acid grassland habitat. He will have some idea of the kinds of plants this will involve but simultaneously, he will also keep in mind that a sedum mat is the most likely to be laid.

The site visit happens very late in the process. In part this is an attempt to manage resident expectation because onsite visits prompt residents to expect projects to start. Officers also know they are likely to be badly received because of past history (which they are not often responsible for and can do nothing about). In addition, the project has to be well on course for completion otherwise it is a waste of time visiting a project which later is abandoned. This means that officers and contractors may not fully understand the physical environment of the roof. On another project, Bentham Heights, none of the sustainability team officers planning the greenroof had visited the site. They designed it as a vegetable garden with full resident access without realising that the roof would not allow this. When I visited, it was clear from stepping

[20]It became a primary tool during the solar PV project. Capitalisation is correct.

out of the access door that so much additional work would need to be completed to make it safe and accessible that the funding was not adequate. A sedum mat was laid and the door locked again to residents.

Each person in the temporary alliance of officers and managers who came together had their own professional task to complete, whether that was providing funding or laying the greenroof. The planting was left to Frank and the others understood that this would depend on many variable factors which materialise through time. These professionals are convinced by the scientific evidence on greenroofs to change their working practices. Officers sign off on million pound projects for LBZ and problems come back directly to them. Responsibility is therefore personal and they have to be absolutely sure that they are signing off on details which will work, will bring benefit to residents and will not be directly attributed to them.

Conclusion

One important aspect this chapter demonstrates is how the current-real and future-imagined roof come together to provide a site for multiple actors across London to cooperate and achieve consensus. The greenroof is capable of being reinterpreted in multiple policy landscapes and by multiple social and political actors. It realigns professional boundaries. George, the Thames Water representative or Wendy, the UEL researcher do not have to know (although they do) or care about the sound reduction and air quality improvement benefits of greenroofs. All they focus on is the hydrology. LBZ officers such as Paul as programme manager and structural surveyor do not have to like plants, ecology or know anything about energy savings. He just has to recognise and agree that greenroofs will extend the life of the flat roof and therefore this will enable him to manage ongoing (and dwindling) maintenance budgets. Joe, head of service delivery just cares about proving and providing benefits to residents and leaves Paul to sort out the structural issues and maintenance.

It might seem contrary to the thesis to demonstrate how the greenroof failed when set within a wider material network of agentive capabilities such as money, plants, rainwater, leaseholders or roof furniture. Not all materials, persons and contexts hold the same agentive capabilities. They exert power at certain times, rising and falling, influencing the project. However, at times some actors in some contexts demonstrate that their agency is stronger than others as they are able to halt a project. The process model of ecotopia is characterised by "manifestation as a process and not a blueprint"

(Garforth 2009:11). Therefore, the idea of "the concept of process as the only possible 'end,' " (2002:97) means that it is the changes in practice which the greenroof enable which requires the focus, even though the roof did not materialise in this case.

Up until the morning the news came in that the project had failed, everyone thought it would succeed and behaved with the confidence and belief that it would do so. The project turned on that one moment and became a delayed or suspended ecotopia. All the material plans, money, networked connections and relationships, flexible working practices and desires to build a greenroof are all still 'in place'. All they seek is a new geographic location. The acid grassland ecotopia envisioned by Frank remains a potential, ready to be brought to life again when a new roof becomes identified. The ability of the materiality of the greenroof enables it to be made visible in many registers, imaginary and then material, but able to be delayed, postponed, re-imagined and flexible to ongoing circumstances: "the imagination of alternatives is not predicated on the wholesale imagination of a utopian figure or wholeheartedly intending hope" (ibid:15). The ends-in-view are still in view, even if they are, in this case, delayed.

10

Privatopia: Localism and Access

> Intention, at its heart, is about the relationship between ends and means, and the purposive action that seeks to bring them together (Garforth 2009:10).

This chapter follows on from the last by re-placing greenroofs within the larger city context. In many ways, this draws all the other chapters together but can also be read as a companion to chapter five. By drawing out again to view the city as an ecosystem (Grant interview:2011), the consequences of greenroofing can be examined in terms of the wider aspirations of materialising ecotopia. McKenna, outlining her process model of utopia indicates: "[t]he model of ends-in-view requires our continual application of critical intelligence, and so the ends-in-view are not as likely to take on a life of their own" (2002:89). This however, relies on an assumption of continual introspection and reflexive corrective action. Further, it relies on the ability to recognise as well as the will and power to correct any perceived injustices resulting from slippages in the utopian ends-in-view. Unfortunately, this is unrealistically optimistic as the chapter demonstrates. I use Kraftl's notion of "conflicting utopian registers" to describe how different communities of practice establish their versions of ecotopia and some of the consequences of this (2010:328). The strategies and flows of power employed by different actors and organisations enable outcomes which may be intended by some and unintended to others.

Firstly, using case studies of roofs in situ, it can be seen how the affordances the roof enables political and material alignments through discourses of localism. Next, the chapter demonstrates how the GLA and some local authorities are using greenroofs as a way of reinventing their role as a provider of green space in the city. They argue, through policy and subsequent practice, not just that they cannot but that they should not be responsible for the provision of green and open space on the ground within their boroughs. The next discusses how the affordances of roofs offer solutions to governance problems for policy-makers, local authority officers, greenroof builders and researchers and describes what is at stake for each group through the sometimes aligning and sometimes conflicting utopian registers. Finally, the consequences of the roof's affordances may result in developing ecotopias for plants, but raises some concerns about what kind of ecotopia this might be for Londoners. Greenroofs align intentionally and unintentionally with the current hegemonic discourses of privatisation. While some groups benefit from greening city roofs, others may suffer as a result. The conclusion of the thesis will outline the consequences of this in terms of public/private access, where London as a developing green or eco-city is also materialising as a private city. Ecotopia is becoming privatopia.

Localism: From the Ground Up

The history of plant use, food and raw material importation, industrialisation and the waste materials of these processes have shaped the ecological history of cities. However, seeds and plants have escaped from botanical gardens, greenhouses, gardens and industrial works e.g. grains from breweries, bird seed mixes, bark and peat mulches. Escaping seeds have diversified in railway sidings and verges, docks, rivers, sewerage works and canal-sides, pavements, allotments and cemeteries – any spare pieces of ground imaginable in the city. While Oxford ragwort (*Senecio squalidus*) escaped from a biological garden and is now colonised all over the UK, other escapees have resulted in 'naturalised exotics' which vary from city to city (Gilbert 1989:24). Bristol is dominated by traveller's joy (*Clematis vitalba*) and fig trees (*Ficus carica*); Swansea and Manchester by Japanese knotweed (*Fallopia japonica*) and Birmingham by bindweed (*Calystegia sepium*) (Gilbert 1989:87-89). This form of plant localism is produced in combination with local weather, soil and other physical conditions. Local forms of biodiversity are "as much a product of the cultural environment as they are a part of the physical landscape" (ibid:5).

Plants in cities take advantage of affordances including rushing street wind and traffic

slipstream which can aid seed dispersal: "[e]ach species has its own ecological preference and method of dispersal" (Gilbert 1989:10). Seeds do not care whether they are carried by animals, muddy boots or car tyres and "many of the species eventually find a vacant niche and become established" (ibid:9). Birds such as the kestrel (*Falco tinnunculus*), pigeon (*Columbidae*), black redstart, starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), gull (*Laridae*) and in USA, the night hawk (*Chordeilinae*) and chimney swift (*Chaetura pelagica*) are active, engaged in seeking new territories and niches within cities. Range extension is afforded by tall city buildings which are similar to cliff faces. These birds carry seeds to new locations. Starlings, which already nest on old buildings, kittiwakes on bridges and kestrels on tall buildings could all find additional affordances for nesting on greenroofs (English Nature 2003:32). Animals, like foxes and magpies behave differently in cities and towns, increasing the chances of species differentiation (Gilbert 1989:4). Within urban ecosystems evolutionary forces exert and provide sites for reordering genetic codes: 'recombinant ecology' (Barker:2000) or what Keulartz (2009), following Soulé (1990:235) calls 'mixoecology'. Gilbert (1998) suggests that many species accustomed to one ecosystem can easily find affordances in others. This is still poorly understood and the critical affordances may not always be obvious.

The Moos Lake Roof

A roof which is used by respondents to exemplify localism is the Moos Lake water-treatment plant which was built in Wollishofen in Zürich in 1914 (photo 12). The facility has an earth sheltered roof to cool the building. At over 32,000m^2 (8 acres) (Brenneisen:2013), it is huge. It is assumed that the 300mm deep soil on the roof was local because it: "acted like a seed bank of regional plant species" which then developed into the "stable meadow community with 175 different plant species" including nine of orchid (Brenneisen 2006:35). Many of these species are rare or endangered in Switzerland, such as the local green winged orchid (*Orchis morio*). This orchid is now extinct on the ground and exists solely on the roof which is now protected under Swiss nature conservation laws.

Elias Landolt suggests the Moos roof: "reflects the species richness of an agricultural region at the beginning of the twentieth century" (Werthmann 2007:35). One ecologist respondent who has visited many times agrees that it is an example of one of the very few grassland greenroofs. Biodiversity develops in a productive relationship to both the past and as an ongoing project of preservation. This preservation stands in

contrast to the ground the building replaced. The roof's lack of localness to London or Britain, does not pose a problem for my respondents who describe it as the "ideal greenroof" (pers. comms.). The effects which the Moos roof bring together are teased out by respondents to describe the conditions of ecotopia physically on other roofs. These effects include longevity. Having remained alive for a century without major repair, it demonstrates that it is possible to protect the building by and from the material alteration for a long time. This is referenced repeatedly at greenroof events and training.

The longevity is based on good construction techniques and this has become one of the markers of the greenroof network in London (chapter four). In addition, the longevity provides, albeit accidentally, what respondents characterise as an authentic and exemplary form of plant localism. It becomes more vital and authentic through longevity, the historical reference point for a material localism which has been lost on the ground and preserved on the roof. The roof's power to remove plants from harm and extinction, provides a unique historical survival evidenced through the preservation of the rare orchid. The hope is that, in the future, British roofs which develop a similar uniqueness will be able to be listed and preserved as conservation sites.

Dusty Gedge's greenroof philosophy is very much one of localism and mimicking "reference habitats" (Dunnett and Kingsbury 2004:175) on particular roofs:

> You want green roofs to mimic the natural landscape. Near rivers, you could have a dry riverbed habitat. In Durham they could have magnesium limestone grass; in Alpine climates you have dry meadow flowers. The more diverse the species, the better. (Gedge quoted in Lee:2009).

Dusty quite literally embodies localism, and greenroofs too, as his nick-name "Mr Green Roof" implies. Describing the Barclays Bank roof in Canary Wharf, he says: "I can take people up there to look at it, and you can see right across London. Which is something for a geezer from Deptford" (ibid).

Similarly, BUILDING GREENer describes "local distinctiveness" as emanating from the physicality of earth "where chalk grassland is an important habitat, using calcareous material on a roof to try to replicate some of the qualities if that habitat makes sense" (2007:11). The 'earth' is a solid, enduring local material which can be repeatedly referred to, reinvented and repositioned as an authentic 'original' source.

Quite literally, the soil of LBZ has been mobilized to represent the character of the borough. Within LBZ, The Sustainability Plan 2008-2012 expresses a commitment to the national sustainability strategy in terms of the "local character and natural environment" of LBZ. The Sustainable Design and Construction Policy section of LBZ's Core Strategy aims to promote "high quality, sustainable design and physical works to improve our places and streets and preserve and enhance the unique character of LBZ" (2007:14). The borough's character is surveyed in ecological terms (for the BAP), as a transport hub and in terms of air quality, which is described as "poor" (LBZ CS 2010-2025). It is also self-described, defining and articulating a local and historical architectural character and appearance for the borough (PPS5 policy HE8, quoted in LBZ Cabinet Meeting 6/6/11) which must be preserved and protected. Visible greenroofs are not given planning permission because this local character outweighs issues of sustainability. Character is also defined by economy which is small but expected to grow, by homes which are expensive and in sociological terms where "the character of LBZ" (The LBZ CS 2010-2025) is described as ethnically diverse, young, well-qualified, working, a centre of migration, but simultaneously experiencing wide variations in life-expectancy, reflecting the enormous divisions of wealth and poverty contained within the area.

This kind of association of people, environmental conditions and ecological features, where different cities have developed as unique urban ecologies, can be seen as a form of terroir: the uniqueness of flavour produced by geography and climate (Pink:2008). Often invoked in relation to how things taste, especially wine or cheese, terroir is the mediation between culture and landscape, an articulation of uniqueness and particular localness. Terroir speaks to an authentic relationship, to something felt to be harmonious and right: 'natural'. These self-identifications and narratives of uniqueness of place align with and mirror the national narratives of localism as a strategy of community engagement and a way of externalising local authority services in terms of austerity.

Localism: From a Different Perspective

The Decentralisation and Localism Bill 2010 was given Royal Assent on 15th November 2011 and has been described as both an opportunity and a repositioning of responsibility for dealing with climate change (PCCC:2010; DCLG:2010).[1] Localism has been

[1] *The Localism Act 2011* undoes the BAP system. All environmental concerns biodiversity, municipal waste management, climate change mitigation and energy, adaptation to climate change, air qual-

in various forms, an actionable political notion since the 1980s through neighbourhood management schemes and homeownership (Flint:2004); micro generation energy systems (GLA:2010); technologies (Bell:2013); tourism and heritage (Urry:2002) and political decision-making (Osborne and Rose:1999). The (1997-2010) Labour Government's *Local Government Act 2000* creates what Raco et al. refer to 'hybrid structures' aimed at new models of 'community governance' through institutional restructuring (2006:475). The Labour Government attempted to link environmental issues at all levels with grassroots activism and community groups (Sefang and Smith:2006) through the *Sustainable Communities Act 2007* which outlines the possibilities for communities to align with local authority sustainability agendas. Labour's 'managerial localism' (Evans et al. 2013:612) concentrated on evidence-based policy-making and featured a concentration on top-down frameworks to enable these alignments while simultaneously realising the need for an understanding of the social nature of sustainability (Sefang and Smith:2006).

Localism remains a contested term and has been reinterpreted by the (2010-present) Conservative/Liberal Democrat government with an emphasis on decentralisation, privatisation and the increase in community-run services. This represents a shift towards a more neoliberal state where: politically, the state is argued to be too big; economically, a high tax economy leads to decline and morally, where people should assume responsibility for themselves. *The Localism Act* positions decentralisation as the best way to deliver better services and that a reduction in and privatisation of the public sphere is required to encourage locally defined and led services. Deregulation of central systems gives increased control of public finances, planning and decision-making to local communities through practices of place-shaping and through participatory politics (Rydin: 2007; 2010b). Localism is positioned therefore, to be more efficient and more democratic in nature.

The Localism Act sets the conditions for this decentralisation and enshrines them within three principles: it gives "General Powers of Competence" so that local authorities are given the freedom to do anything which is not against the law; it offers "Community Right to Buy" so that "communities can bid for ownership and management of community assets" and it reforms the planning system to enable local communities to shape their own locales (DCLG 2010:7). These build through a wider strategy of privatisation and deregulation across all sectors.

ity, and ambient noise (Section 225) are combined within *The London Environment Strategy*, informally known as 'The Strategy'. This includes a general assessment of Greater London's environment and provisions, policies and proposals and any other environmental matter the GLA (Mayor's office) considers appropriate.

Even though the Act was not in full force during fieldwork, the agenda which informed it was well understood and broadly supported by officers as coming out of a general sense that more community engagement and involvement was a 'good thing' even if this was difficult to manage at times. It alleviated some of the pressure on their work load and responsibility even though it did not always result in what they would regard as a suitable outcome. The Act, as it passed through parliament was already reshaping the working conditions of the local authority officers.

At the same time as central government has given local authorities more power, discretion and autonomy through The Localism Act, council funding has been reduced, reshaping service provision. As Evans et al. suggest, only: "responsibilities, rather than power or resources, were devolved" (2013:403). This has pushed, nudged or empowered (depending on your political standpoint) local communities to take more control, improving, steering and paying for their local services, buildings and open spaces. *The Essential Guide to the Decentralisation and the Localism Bill* indicates that one of the "practical steps" to decentralisation is the creation of conditions for community participation and empowerment (ibid:2). Across London and the country volunteer initiated and led grass roots projects such community gardens, Edible Towns, areas, like Edible Lambeth and Edible Bus Stops have sprung up. These have been encouraged and complimented through funding by programmes like Capital Growth. This is a partnership between the GLA, London Food Link and is supported by funding from the Big Lottery's Local Food Fund (Capital Growth:2014). The GLA and local government are promoting and encouraging community groups to appropriate areas within housing estates and other spaces for food growing. John Little, the greenroofer discussed in chapter three works with estate residents on the Clapton Park Housing Estate in East London to do just this. Lack of space with a waiting list of five years on the estate's allotment meant that there were people interested in forming a resident's community food growing space there (pers. comm. See also Monks:2009).

In other areas, the management and running of local parks and open spaces is being transferred to local groups powered by volunteers. Brockwell Park in Herne Hill, South London is one such open space, managed by loosely connected groups meeting to make decisions on the running and funding of the space. There are schemes like community vegetable growing in the greenhouse, a scheme for retired people to restore the 'original' cottage garden of a gatehouse and a group dedicated to increasing the biodiversity through the park. They raise money and have identified areas for wildflowers, planted a long hedgerow and a bank of daffodils. Regeneration of the Brockwell Lido changing room block is to include a greenroof to increase the biodi-

versity and visual aesthetics of the park as well as to decrease the water run-off from the roof in storm events.

In the same area, The Urban Wild Project is another example of 'active citizenship' (Kisby:2010). Concerned with the lack of action on adapting infrastructure to climate change, a group of volunteers set up a project to install greenroofs on two rows of shops in Herne Hill.[2] Dusty Gedge was involved, both as a person of expertise and as a designer and builder. The group is as much a way of consolidating social ties and friendships as it is an environmental problem-solving group. People here call Herne Hill a village, and it is a relatively wealthy area, standing in contrast to nearby Brixton and Norwood. Even if people do not, strictly according to postcode, live in Herne Hill, they often claim allegiance through residence to the area. People who live in the Herne Hill side of Tulse Hill and Dulwich often claim residency (pers. comms.). The area has many retirees, women with children and professional people with extensive networks and connections who volunteer for local projects, of which there is a large variety. These groups seek to produce local exceptionalism and uniqueness of character, exhibiting the overall project of producing a particular vision of nature, one which is as productive, self-sustaining and self-reliant as they are.

Footprint and Amenity Replacement

Roofscapes are intimately linked with the ground in more ways than the biological. While linking roofs with biodiversity meant that the greenroof network, including LBZ sustainability officers could argue to increase green space for biodiversity, it also meant that they were able to link this with increased green space for amenity. The conservation of biodiversity within local authorities is a statutory duty described by Section 40 (S40) of the *Natural Environment and Rural Communities Act 2006* (CABE:2009), and this has been linked with the statutory obligation to maintain and enhance open space provision under Section 106 (S106) of the *Town and Country Planning Act 1990*. Access to green space, historically linked to the parks movement of the 19th century, relies on a relationship between people and urban space which is intimate, beneficial and improving (Katz and Kirkby:1991; Cook and Swyngedouw:2012; Hebbert:2008). This is enshrined as an Act of Parliament and enforced through local authority planning divisions. Linking biodiversity with open space provision is effective for the greenroof network generally and the LBZ sustainability team specifically in order to get greenroofs funded and built. Greenroofers recognise that local authorities,

[2] I am part of that group.

businesses and property developers see the possibilities for increasing amenity space within the development of London as a compact city. The affordances which roofs provide enable not only the materiality and biodiversity in terms of a footprint strategy, but the ability of the function of the ground itself, to be replicated and reproduced.

The twin pressures of austerity and the move towards density within London, reveal themselves in documents, where local authorities now claim a shift in the management of urban space by describing, through bureaucratic and planning management, that the public should expect open spaces on the ground to decline. This becomes linked to an expectation that roof spaces could and should compensate. The idea of an architectural footprint replacement, in combination with discourses of austerity and localism, enable the GLA and local authorities to reinvent their role as providers of green, or open space in the city. *The London Plan* encourages local authorities to use greenroofs to replace open space on the ground. Policy 5.11 describes:

> Enhance amenity value – Accessible roof space provides necessary outdoor living space in London. This will become particularly important as planning policies start to drive a more compact and denser urban form with proportionally less space for immediate gardens. As such, accessible roof space can be viewed as an integral element of a well-designed, high quality, high density, more efficient, attractive and liveable city (*The London Plan: S5* 2011).

This emphasis on the roof as a replacement for lost space on the ground is being replicated throughout local authority documents and planning statements across London. Both Westminster and Islington councils cite *The London Plan* and Natural England (2003) recommendations to incorporate more green infrastructure into their strategies for managing open spaces (Westminster City Council 2007:28-9). Islington council is particularly concerned about its position as second lowest for the amount of open space of any local authority in the country (Islington Core Strategy Topic Paper: Open Space and Green Infrastructure 2010:2). They specifically indicate that greenroofs are potential multifunctional spaces to correct this (ibid:8). Camden council's *Open Space, Sports and Recreation* suggests, in response to the raised demand for allotments, that this may be provided for by "the provision of living roofs" and LBZ has a network of documents of which this is typical:

> Outdoor amenity space provides an important resource for residents,

> which is particularly important in the borough given its dense urban environment. It can include private provision such as gardens, courtyards and balconies, as well as communal gardens and roof terraces.

This suggests an unproblematic replication of one type of splace for another. If a park is lost on the ground: replace with a balcony or terrace, or build it on the roof. As Tilley (1996) notes, places created or exposed to market forces are subject to a rationality which homogenises them in character and potential exchange value. Places become "desanctified, set apart from people, myth and history, something to be controlled and used" (Tilley 1996:21). Greenroofs however, are not like-for-like replacements for lost ground based amenity.

The Living Roofs Case Studies (GLA:2012) is a booklet designed to demonstrate how roof tops can provide like-for-like replacements. One example is the Jubilee School roof in Tulse Hill, south London (ibid). Schools, especially primary schools have embraced greenroofs because they solve multiple problems. They provide access to nature in the form of growing plants without having to take children on field trips, and if accessible they solve the lack of adequate open spaces for children to play, especially in urban areas. In addition, the benefit of safety and security which comes from restricted access and visibility has become one driver for school greenroofs. This (perhaps unknowingly) mirrors the movement of the late Victorian and the early Edwardian periods where impoverished London children were educated in schools where the roof tops had play areas and open air 'swimming pools' for daily washing. The Christopher Hatton primary school,[3] built in 1876 was later extended with a play area constructed on the roof. It is now part of Gray's Inn Buildings (Temple 2008b:109-139). Penton Grove School, on White Lion Street, built in 1874, extended in 1899 and closed in 1971 also featured a roof top playground (Temple 2008a:373-404). Both schools literally and metaphorically raised children from the poverty and squalor of the Somers Town area of London and placed them above it all.

Of the other 16 roofs detailed as *Living Roofs Case Studies,* leading the way for greenroofs in London, three others are greenroofs on the ground, the Jubilee Gardens at Canary Wharf, an earth sheltered roof on a community centre and a cafe roof in St. James' Park. As detailed in chapter six, these may not technically be greenroofs for some people, but here they can be described as such when required. Of the remaining 12, all are either residential, commercial or a mix of both.

Some of these examples also appear in the *The Technical Report*. By relying on interna-

[3] Previously Laystall Street school and later known as Rosenbery Avenue school.

tional examples of expansive and strong roofs, the report gives examples of amenity space for dog walking and farms on large roofs in the US and football pitches on car park roofs in Birmingham. The report suggests this is replicable for London (2008:11). The Springbok Works in Dalston and the Gap Project in Golden Lane are provided as examples of workable roofscapes when other forms of amenity were not possible to provide (2008:11-12, 20). However, Springbok and Gap are both examples of dwellings with private roof terraces, not replacements for large areas for public dog walking, football pitches or farms (GLA:2012).

Even as they argue the importance of open spaces, LBZ are identifying open land and property which can be sold to finance statutory obligations and fund essential services in light of the shortfall from central government:

> The first issue is to get more homes. That is our priority. Our second priority is to invest cash in our dilapidated heating systems. … installing double glazing and insulation … A cyclical repair programme is an aim that would help us save cash in the long run (2012).[4]

Many London boroughs now argue that they do not have the funds to meet their obligations to provide and maintain parks, allotments and open spaces. More than this, they should not be expected to do so. This shift is almost invisible because it applies to fragmented (and often small) open areas and parks which are bundled with buildings, out-buildings and disused parcels of land. In addition, while this is included in publicly available documents, it emanates from different departments, is offered through specific channels only to interested parties and becomes buried by the boredom of bureaucracy.

LBZ commissioned a large property firm to investigate possibilities for raising revenue. By investigating the full property and land portfolio, they returned a list of 180 'opportunity sites' which could be sold to raise money.[5] These, like *The London Plan*'s (2011) 'regeneration areas' become identified as sites of possibility for raising revenue. The list includes community centres, car parks, hostels, industrial units and workshops, children's centres, schools, GP surgeries, a police station, shops, social housing and residential street properties. Potentially, these London properties can be extremely lucrative. This signals a wider trend of selling council properties to maintain statutory obligations. People worry that this privatization means loss of open space, buildings and services, as well as unrestricted planning permission for

[4]Reference withheld for anonymity.

[5]Mirroring the 'opportunity areas' in the 'Abercrombie Plan' (Forshaw and Abercrombie:1943).

new developments, high or undesirable buildings (pers. comms.). Respondents have a deep concern that after this round of asset-stripping, what will be next?

While it is important to note the sale of multiple buildings, what is relevant to the argument here, are garages, open ground and small parks. Garages attached to social housing have been described as derelict, a sign of changing lifestyles and unnecessary because of public transport. Because of the way cars require room to turn, they often stand on substantial pieces of ground, and as one elected councillor indicates in an LBZ local paper: "[g]arages cost a fortune to maintain and they are often simply left empty … Having a garage is not seen as essential. The same goes for smaller sheds on estates."

One group of 14 opportunity sites was grouped together and issued for consultation for sale in 2012. Seven of these are sets of garages, two are car parking areas and one is a row of sheds. Several are multiple use, for example, one set of garages has an adjacent park. Three further areas are described as hard-standing and of these, one is a hard-court games area, one a communal area and one a car parking area which has been appropriated for multiple uses, including hanging washing, playing cricket and football (with the goal posts and stumps painted onto the wall) and as a seating area with chairs and a picnic table. These changing and informal uses do not achieve official standing in order to keep them from sale. Five pieces of land are described as 'landscaped' and include a park and a grassed area.

These pieces of land, like brownfield sites, have now been identified by LBZ as wasted spaces with the imperative that they be put to good use. The same councillor quoted above said (in a different newspaper interview):

> It is vital the council instigates a thorough survey of every piece of property it owns and ensure it is being used properly … There are some open spaces, of course, that we would not dream of considering, but there are also some that are simply covered in dog excrement and used by drug dealers.

Redefinition of 'proper use' conjures up the early European colonial re-interpretation (Anderson:2005) or non-recognition (Kendle and Rose:2000) of the land-managing practices of native populations. Not making proper use of land, i.e. in a way recognisable to the colonial settlers and their administrative technologies leaves the land open to be ceased. Letting the land be used by locals here has resulted in contamination, much like the Mill Lane community centre, both by undesirable people (dog

owners, who allow their dogs to foul, or drug dealers) and by the actual dirt itself (dog excrement and drugs). The councillor expresses the moral obligation to sanitise space through regeneration.

Rooftop provision is not replicating the on-the-ground footprint. There are no hard-court games areas, playing fields, parks or picknic areas being built on London's roofs. Dividing land up into small parcels allows the relatively uncontroversial transfer of public land now regarded as wasted or unproductive space into the private sector. The attention is diverted from the widespread sale to the local and each piece of land becomes subject to fragmentation, so that each is presented on a piecemeal or case-by-case basis which means that pieces of land which attract no attention are sold and transferred. The families who lose their washing line, games and seating area are not gaining an accessible greenroof space they can use for these activities: they are gaining neighbours.

Roof-top Food Growing

In just the same way as the ground-level greenroofs can form a liminal category, included and excluded at will, so too can food growing roofs. Vegetable growing roofs show the dynamics of both like-for-like replacement and lead into a discussion on the private nature of roofscapes. As discussed in chapter six, many do not consider vegetables biodiverse enough to fully qualify for the category greenroof. For others it is the amenity which proves exclusionary. However, the inclusion of vegetable garden roofs enables greenroofers to argue for more plant-rich roof spaces overall and they recognise that local authorities are attracted to the extra amenity space provision. Vegetable roofs lie at the heart of the space provision argument at LBZ. At LBZ, vegetable garden roofs are greenroofs.

Food growing has been provided for in urban areas by the provision of allotments going back to the British Civil War (1642-1651), shaped by the history of the Enclosures of common land of the 18th century and important in the urban environment since the start of the industrial revolution (Cherry:1979; Crouch and Ward:1997; Barclay:2012). Local authority provision is a statutory requirement, enshrined in the 1908 *Small Holdings and Allotment Act* and allotments are council-controlled and regulated by laws and by-laws. This is acknowledged in the Mayor's *Draft Replacement Plan*: "[b]oroughs should protect existing allotments and identify other potential spaces that could be used for community gardening (GLA 2010b:192). Selling or reissuing

allotments requires consent from the Secretary of State for Communities and Local Government and is subject to conditions including the provision of proof that the allotment is unnecessary and unwanted. With waiting lists running to 20 years or more in some boroughs, and 10 years in LBZ, this kind of proof is difficult to produce.[6] In LBZ existing provision of allotments is 1.68h with additional need estimated at 19.33h (OSS).

For LBZ to sell already active growing plots seems contrary to their stated obligations, especially when they acknowledge the huge demand. However, two of the opportunity sites identified above are community-run, active food growing plots. One is described as communal landscaped. A third community garden in LBZ has also been identified as an opportunity site and the residents are now trying to defend it. Community gardens like these, even if they are identical spaces to allotments and have council consent, have no statutory or legal protections (LAEC:2006). They may be run and appropriated by volunteers but because they are owned by the council, it has the power to offer them for sale.

The Localism Act gives communities the 'Right to Buy' different kinds of local assets threatened with closure or sale, such as these food growing areas. Community groups are given time to form and prepare funding bids. This process now becomes a test of whether local people want to maintain these areas for their own use, whether they can actively and successfully defend them and ultimately, what they are willing to do to retain them. The value of such pieces of land is homogenised and equalised as they enter the market. The importance and significance is then judged by whether local people wish to 'save' a site from the market, ironically by buying it and then owning it as a 'local asset'. This may involve organising maintenance, forming resident's committees, fun-raising and recruiting volunteers. Those pieces of land which attract active residents, supporters and funding have a good chance to remain undeveloped (at least in this round of asset-stripping). Those spaces which are used by residents who are unaccustomed to campaigning, or who do not have sufficient resources such as money, computers, time or social capital, may fail to be retained by the council and sold to developers. Selling the plots of land then becomes justified, though lack of community engagement or neglect.

By directing the focus onto the formation and empowerment of local community groups, the Localism Act transfers concerns which were previously under the purview of the national to the local. Debates and tensions move away from national policy (which is now argued to be draconian and unresponsive to local needs)

[6]For the different kinds of ownership models for allotments see Campbell and Campbell:2013.

and becomes split into multiple fronts, targeted through each local authority. The forestry debate of 2011 is an example of this. The national outcry when consultation on the sale of the Public Forest Estate was announced led the Conservative/Liberal Democrat government to backtrack the proposed privatisation. However, forests and in particular ancient forests, can be redefined as local assets under the Localism Act and this fragmentation enables their sale on a piece by piece basis.

In the Essential Guide to the Localism Bill, the word privatisation does not appear anywhere although this is at the heart of the strategy, and this is at stake when people are invited to buy local amenities which were previously council owned. Vegetable gardens (and other kinds of property and land) which are saved from sale by the intervention of local, community or voluntary-led groups who undertake to manage and fund them are still sold, albeit to a non-profit organisation. This kind of transfer of land is privatisation, although it may not be thought about or discussed this way. These groups, even though they act communally, act for themselves with the power to include and exclude at their discretion. They also have the power to sell the land or property assets they have acquired, especially if they are unable to maintain them on an ongoing basis. People may think of these spaces as communal, but in legal and practical terms, they are private.

As the House of Commons Library note (SN/SC/887) on allotments makes clear, Section 8 of the *Allotments Act 1925* allows the regeneration of allotments, providing local authorities issue alternative sites (Barclay 2012:3). London authorities have started to sell allotment spaces, with the backing of the Secretary of State on this understanding (BBC News:2007; Geoghegan:2013). The Mayor's Draft Replacement Plan argues that greenroofs replace the lost ground: "Particularly in Inner London innovative approaches to the provision of spaces may need to be followed, these could include the use of greenroofs" (GLA 2010b:192). This is mirrored at LBZ:

> 5.38… However it is recognised that in certain parts of the Borough securing traditional allotment gardens may be difficult to achieve. There is a need to be flexible in how the standard is achieved, this could include: community gardens; roof gardens; converting parts of existing open spaces to allotments/community gardens; and urban / derelict sites can be used for growing vegetables in large earth containers. Innovative approaches to achieving the standards should be encouraged (LBZ OOS:5.8).

This subtle use of language changes a statutory obligation into a standard. An obliga-

tion is definite, a standard is a goal to be achieved and is therefore more flexible and movable.

The LBZ Green Action for Change: The Environmental Sustainability Delivery Plan 2011-2020 claims: "126 registered food growing sites including estate gardens, roof tops and community food growing projects." When I enquired, no-one could even suggest where these figures came from, let alone name the roof-tops which are claimed. I found no more than five roof-top growing sites in LBZ by the end of 2011, although there are, by 2013, just under a dozen and the number is growing. This is still not substantial.[7]

Return to Eversheds

Typical of the new vegetable roofs in London is the Eversheds roof, discussed in chapter six. The roof is part of Evershed's corporate policy on sustainability and their website speaks of how important to the wider public conception of the company the roof is as part of a raft of building modifications undertaken. An Eversheds Report, entitled *The 21st Century Working World* details the extent of their idea of how the roof fits in technically to the concept of sustainability. They omit to mention that by this time greenroofs are a policy requirement of the City of London, but it is given great importance within themes of energy use, transport, waste and materials which make up the sustainability statement (Adams:2008). When the office was opened opened it boasted a gardening club. The garden space complied with the GLA standard of 28% amenity and 70% space for biodiversity. At the time, Steve was the only person interested in gardening once the publicity died down. Steve is the building manager, and over the course of several years, he has increased his garden from a modest collection of sprouting carrots, tomatoes and lettuces to an extensive array of growing pots and tubs with fruit trees and a grape vine. By the summer of 2011, a couple of gnomes stand on friendly guard. Fruit trees are a long term investment, costing upwards of £15 and taking two years before they produce fruit. This spells out a confidence that he intends to be an employee for the foreseeable future. Steve reports that no one else in the firm is interested in gardening, except for two other employees who keep a couple of bee hives in his garden. Across the roofscape on the next building we can see another couple of hives and on one visit there is a bee-keeping course in progress.

Steve admits that he does not have the income to afford a garden flat, so he relishes

[7] And I always admit the possibility that I overlooked some – although it still does not add up to many.

the opportunity, space and outdoor facility the greenroof gives him. This is his way of securing a link to his childhood where he learned to garden. Other employees seldom visit the roof, he says. On the other hand, the chefs are encouraging him to grow vegetables for the cafe and he is excited and proud about doing this. On my last visit in September 2013, Steve is no longer with the firm and has removed most of his fruit trees. Several others have taken over the gardening club and are growing predominantly flowers with a few lettuces and tomatoes.

The affordances of roofs to provide the isolated and rarified conditions for greening to remain undesturbed enough to develop the webs of biodiversity required of them becomes an affordace for gardeners. Across London, almost all vegetable gardens on roofs are either private or provided by firms for their employees. These include Coutts, 400 Strand, The Bloomsbury Street Hotel (Mavrogordato:2013) and the law firm of Olswang. Others are closely connected with cafes, for example the London School of Economics supply their own cafe and Acorn House Restaruaunt in Kings Cross is partially supplied by roof-top vegetables. Budgens grow produce for sale with the help of volunteers on the roof above their supermarket in Crouch End. While the proliferation of roof-top gardens and vegetable growing spaces is attractive, commendable and enjoyable, the larger issue of ownership in London is at stake.

Many private vegetable gardens are described as allotments. Pinsky and Delcroix for example, provide a typical description of visiting "an allotment on top of an office building" (2014). The vegetable garden on top of the new Vermillion building in Canning Town is also private, but again is being called an allotment (Muse Developments:2013). The Eden Project's vegetable garden planted and maintained by ex-prisoners and homeless people at The Southbank Centre is a private space behaving as if it were public. However, these vegetables are hardly ever harvested, despite this being one of the claims for the project (Hannah:2011). There are also a number of private roof-top growing spaces, and one community run scheme, the Doddington and Rollo Community Roof Garden in Batersea, but at the time of writing, there are no known open allotments on rooftops. The term allotment refers to the legal relationship with a local authority within a framing of land as The Commons (Crouch and Ward:1997). The vegetable garden can not qualify for this formal relationship unless it is open to everyone equally. It is possible to grow fruit trees, flowers and keep chickens on an allotment but not necessarily grow vegetables. Calling these growing spaces allotments enables the GLA and local authorities to elide the legal definition and talk about transfering allotments onto roof-tops unproblematically.

A substantial proportion of greenroofs lie on top of commercial buildings (like Ever-

sheds) where they are either inaccessible to the general public, strictly limited access, or require being a worker of the company. This is especially true in the City of London. Many of the new rooftop amenity spaces are commercial: bars, restaurants and cinemas. Businesses have found that their clients, workers and customers like dining, walking and relaxing in a rooftop garden or terrace. In 2009, Selfridges on Oxford Street reopened their roof garden with a pop-up restaurant by Pierre Koffman.[8] In 2011 they had a roof top cocktail bar and rowing boats which were inspired by a 1905 gondola party in the Savoy. In 2012 they held a tea and golf party. Cannon Street Station with its extensive multipurpose roof can be hired for events such as weddings. The Kennsington roof garden is publically accessible during the Open London Weekend, which falls in September, otherwise the resteraunt is open to paying customers for dinner at upwards of £40 per head. A growing number of greenroofs are privately built: sheds, garages or roofs, like Bluebell House.

Do these kind of roof top schemes replace allotments, community gardens parks and open spaces which are at risk? The answer is no, because accessibility is reserved for employees, residents or customers and is not open for everyone. It is not a universal[9] and common right as a citizen. Minton (2006) suggests that from the 1980s onwards, the shift from public to private space within London was invisible. Public spaces, brought into private ownership superficially look, feel and act like public ones, but are not. Since the Olympics and the Occupy Movement, the contestation of privately owned and managed space in London has become more visible. The discourse of space provision by greenroofs will further exasperate the move towards privatization which signals lack of access to both open and accessible green spaces within London. Due to the isolation afforded by roofscapes, greenroofs are generally not open to the public.

An example of what might come close to a public park on a roof in London is the new building 20 Fenchurch Street, designed by Rafael Vinõly, which is currently under construction and affectionalty named 'The Walkie Talkie'. Its shape, which is

[8]Built in 1909, one could take afternoon tea on the roof top pleasure garden in the 1920s and the roof had shooting ranges, (women only gun club) and a golf putting green. It was closed in 1939 to grow vegetables for the cafe but the roof garden was destroyed in the Blitz.

[9]Universalism as a concept is under threat. It is much easier to argue for when people are more equal, socially and financially. In terms of benefits, it was argued that by universalising them it became a way of including everyone who was eligible and this ensured fairness. However, as wealth and poverty become increasingly polarised under contemporary neoliberal conditions, the debate on fairness now centres on how unfair it is that the wealthy are included in universal benefits such as the elderly heating allowance or child maintenance payments. It is now becoming increasingly unfair that people with gardens should be granted allotments. Neoliberalism proposes neoliberal solutions to its own problems.

narrower at the bottom than the top, is a statement recognising the lack of available space in The City. The skygarden, on the top storey is intended be open to the public but it is similar to Canary Wharf: a seemingly public but actually private space.

Access, Railings and Gate Keepers

> Section 11.27 … the provision of a roof garden as a contribution to public open space may be considered. If a roof garden is to be considered as public open space, as a minimum it should be able to be used by all the occupants of the building (LBZ PPG6 Amenity:65).

Private roofs are for residents only, commercial roofs privilege customers but at LBZ, the sustainability team's roofs are not replacing lost ground amenity, not publicly accessible and not accessible by residents either. Of the greenroofs the sustainability team have installed, most were initially designed with resident access and features such as vegetable growing. The exception is Dewey Court which has a barrel shaped roof and requires a full arrest system for access because it would be very easy to fall off the slope. Resident access is always gradually reassessed through the lens of funding or health and safety as the materiality of unsuitable roofscapes asserts itself. Every completed greenroof has been rolled back to an inaccessible space.

Even one early greenroof which was pictured in the local paper featured a local councillor and members of the community (but not Tom who had managed the project) standing on the roof during the opening ceremony is now closed. So, despite the best intentions of officers, in the end, none of their roofs afford resident access. The isolation which is so important for the development of webs of biodiversity becomes problematic for human use. Social housing roofs were almost never initially designed for amenity. They have accrued alternative uses over decades: storing equipment, siting antennae and weather stations or resident satellite dishes (which is not legal, but is one of those practices council officers ignore). They are accessible only for maintenance staff and are often a maze of trip hazards such as raised pipes and low walls over which it would be easy to stumble, like the Norcross Close roof. There are minimum legal requirements for resident access and these are expensive to implement.

One LBZ roof, in the planning during 2010 and 2011 was designed by the team as a vegetable garden with areas for beds, growing tubs and fruit trees. However, as time went on these plans were reduced little by little and in the end a sedum mat was laid and access denied to local residents. Frank indicated that the money ran

out. When I visited the roof myself it was very clear that the whole area was unsafe. The roof door was at the top of a steep set of stairs, inaccessible for many. It led out onto a landscape of raised pipes and trip hazards, with no stairs to the main roof area, so access required climbing onto a three foot high section. In addition, once on the main area, the walls were insufficiently high to prevent falling over eight stories. Health and safety standards would have been extensive and expensive in order to allow resident access. The roof plans underwent several major scale-backs from garden roof to wildflower roof mimicking acid grassland. At one stage Frank attempted to attract volunteers to keep planting costs down. Even this fell through, and the cheap and basic solution of a roll-out sedum blanket was laid with no access granted to residents.

Railings

During an LBZ sustainability team meeting, we discuss railings. There are two kinds of ways of keeping roofs safe: handrails or failsafe systems. Failsafe, or fall arrest systems are designed on wall-less or barrelled roofs (like Dewey Court) which never have resident access. This is a system of hooks and lines secured permanently into the roof and onto which workers/officers harness themselves, so that even if they do slip and fall, they will never reach the ground. Tom explains that: "some sort of health and safety thing is required otherwise you are not allowed to have any person on the roof unless they are certified – with the training". This is a one day course and passing it is a legal requirement to use the system. The second railing system is the handrail. This is a minimum standard before resident access is allowed. There are many different kinds and the regeneration team have their own preferences. Frank often consults them and knows which they prefer to meet the legal requirements.

Installation of railings means greater initial cost "but actually they pay" says Tom and Frank finishes the sentence "for themselves really quickly." A neighbouring council installs railing as standard on all projects and they "pretend that conservation areas and planning require them" (pers. comm.). This constraint is balanced with the knowledge that, as Frank warns, railings can be visible so: "you do carry the risk of clashing with planning." A neighbouring council fits railings as standard and they "pretend that conservation areas and planning require them". This is an interesting strategy to bypass regulations, which they consider, but reject as not realistic in LBZ. After some discussion about the cost of railings, Davina plainly states, of the residents "we don't want them up there".

One leaseholder I spoke with standing on his section of Norcross Close roof had an understanding that officers did not want him there. He indicated, in frount of the council officers who were present, that "we do not use the roof" as "we have two kids" (pers. comm.). However, later as we talked further and after the others had moved out of range, he intimated that the roof access was one of the reasons he and his partner bought the property. They sit up there occasionally.

Mill Lane Revisit

Community access and engagement are always cited as part of the rationale for laying a greenroof at LBZ. Mill Lane roof's raison d'etre was the transformatory power of nature on both the building and on people. It was thought that a vegetable growing scheme set up the previous year at the back of the community centre by Sandra pointed towards a growing awareness of green issues that the reinvogorated roof could support, and an area of raised beds for food growing was always intended for the project (email comm.:2009). The approved specifications compiled by Dusty Gedge confirm that the intention was to provide a "multi-beneficial green roof" (Approved Specifications:09).

> To provide the widest range of benefits to both wildlife and human communities three different treatments will be applied to the roof sections. These will consist of extensive green roof element designed to incorporate wild flowers, semi-intensive green roof element to provide both a gardenesque element and a rich nectar forage area and an Intensive green roof element to provide for some food growing with in the roof complex (ibid).

Funding application documents written to SITA and internal LBZ business case documents all emphasise the access the roof affords. It was intended that people would be allowed to see and work in the flower and vegetable gardens. This vegetable growing area had to be abandoned because there was a minimum requirement for the greenroof area laid down by SITA and the existing space only just accommodates this.

Despite the healing force of nature and the officer's claims that the roof would be open, the Mill Lane roof remains closed. Local residents initially exhibit indifference to the building. However, after the roof starts to flower and becomes visible, this changes. Conversations with local residents reveal an anger at the locked gate and the lack of access. People want to see the flowers up-close. More than this, they

believe that they should have the right to do so. They do not see why they should be excluded because they "are doing nothing wrong" and they are puzzled and angry at the council's restrictions (pers. comms.). This single storey building could easily provide access as photograph 10 shows.

Meanwhile, the roof is still closed to all because of the damage and graffiti and for safety reasons. The sustainability team have competed their project and moved on to their next task. When I ask to visit the roof, after completing fieldwork, I am directed through the LBZ office, not the centre manager or the resident's committee. The officers do not have either the time or the interest in organising access, because they feel they personally need to accompany every visitor. However, they are willing to do this as a special favour for me, but I decline knowing they are busy and visit alone.

My latest visit in autumn 2013, is deeply disappointing. The building is boarded up and abandoned. Graffiti covers the whole building, more than it did before the restoration, and it is clear that it has been the target of deliberate destruction. The roof habitat for flora and fauna is as 'wild' as the brownfield sites it is argued to mimic. Isolation and wildness have been achieved for the roof but the restoration and healing for the residents has not. While the roof is abandoned, it is more like the brownfield site than ever. Returning to the mantra "if you build it they will come" appropriated by Rosenzweig (2003) to describe the provision of affordances for the flora and fauna, the roof has come full circle. Built to look and feel like a brownfield site, in order to accommodate the kinds of biodiversity typically found there, why then, was everyone surprised when local people (perhaps the undiscovered drug-users) started treating the roof like a brownfield site?

Dusty says: "the visual is a major issue when it comes to greenroofs. … a major stumbling block to achieving greenroofs" and attributes this to brownfield sites being "aesthetically unattractive" (interview:2011). People working to install the biodiverse roof either forgot or took it for granted that nature has to be learned. The "alternative aesthetic norms and sensibilities" which David Orr suggests are developed by "connecting people with landscapes grounded in sustainable principles … aiming to foster native species" were just not communicated to anyone outside the greenroofing community (1992:21). After the project is complete the materiality of the greenroof lives on, continuing to be agentive.

However, the aesthetics the roof displays are recognisable to certain persons or publics only, despite the stated intentions of multiple social actors. Barad's (1998) example of the postbox, which affords posting is an example of how cultural normativity makes this affordance possible and accords with Dant's (2004) argument

that if affordances are social, they need to be learned, found, discovered, and can be designed into things see also (Bloomfield et al.: Costall:1995; Suchman:2006). The aesthetic which the greenroofers enjoy, "scruffy" as Gedge calls it, tumbling with flowers, patchy in places with bare stones for much of the year, is different from garden aesthetics which demonstrate a visible, colourful, year round, regimented care (pers. comm.). Made to look like a derelict, unkempt, brownfield site - no wonder it was treated as such.

These new greenroof aesthetics have to be learned as surely as older landscape and nature aesthetics initially do. No attempt was made to inform people, residents or centre-users that this was a 'special kind of nature', deliberately built and designed for biodiversity, nativeness and wildness. The residents were not engaged, the site remains tucked away and badly lit, unused by the African community to whom it was dedicated. The building did not assemble community in, round or through it. There is no will to use the site or to upkeep the centre. The redecoration and addition of the greenroof in and of itself does not regenerate a site. Regeneration as a socio-biological metaphor has suceeded for the biological because the flora and fauna have their own life-worlds separate from human sociality as well as entangled within it. But it has failed the social because this takes continual commitment, work and money which are all lacking.

Gatekeepers

In addition to LBZ officers who do not want people on "their roofs", there are other communities of practice who share this view (numerous pers. comms.). The claim on personal ownership that this implies reveals the way individuals also take on an ethics of care, mediated through their professional disciplines. Ecologist researchers do not want people on the roofs either. People are capable of damaging their long and often costly studies. They wish for as pristine and 'uncontaminated' a research roof as possible. While they can not control many of the variables found of roofs (which is what excludes biology and ecology from being classified as 'hard' sciences) they are able to control for potential danger from interference by people. Many universities have set up test bed roofs (photograph 13) which isolate the plants from non-researchers and the quality of the scientific investigation is predicated upon the success of this isolation. One researcher, Timothy describes how walking disturbs the biodiversity near paths in the countryside. Increased footfall and straying off the path mean that plants and animals are disturbed or destroyed. The same principle

applies on roofs, he explains, because people are not respectful of nature and so he, like others, does not want disruption by untrained people on 'his' roof. Test roofs tend to be highly restricted places for these reasons.

This role of protection is enabled by the isolation roofs afford and is a vital requirement for the development of biodiversity and wildness. Hawthorne Heights is an example of this. Isolated for years by inaccessibility for residents and a gatekeeper who does not care about the plants, enables them to develop the quality of wildness through disengagement with the human social. At Mill Lane, the provision of habitat for local invertebrate populations becomes entwined with isolation. Local authority officers also cite this as a reason for restricted access to the roof. However, these groups of people who argue for restricted access also expect unrestricted access for themselves. Timothy, the greenroof researcher does not want people walking on his roofs because of the destruction they might cause. In a similar fashion, the Mill Lane invertebrate researcher does not want people disturbing her research either. She enjoys unlimited access and visits several times per year to collect specimens of invertebrates and take them away for analysis.

Another person granted access is Dusty the designer and builder. He is contracted to inspect the roof four times a year during the first few years, and he combines this with leading his greenroof courses at the community centre because it has a meeting room large enough for this. During the course of the training, attendees are allowed to wander among the flowers (photograph 10), where the residents are not. The roof remains closed to local residents.

Without exception, every roof I visit has a gatekeeper, a keeper of the keys. Access through buildings requires consent, a climb up stairs or ladder, is connected with the maintenance team, a locked door and guardianship. These can not be open, freely accessible places when access is granted through a building. Even the RISC permaculture roof garden in South London which can be accessed externally to the centre has a locked gate because of the possible threat of vandalism (pers. comm.). However, it is the greenroof's location, on the roof, which reveals the way in which even if geographical and built environment boundaries within the city are challenged, the overall effect is to strengthen the isolation experienced and ultimately this is what different communities of practice working with greenroofs want.

Privatopia

The isolation roofs afford aligns with notions of security, protection, health and safety, improper use, isolating experimental science, protecting property and ESS, successful plant growth and the resulting wildness which greenroofers desire. This isolation, complimented by plant choice and monitored closely by gate keeping practices which ecologists and researchers support, leads to very particular constructions of localism which have resonances in national discourses. This is localism from the ground up, and on the roofscape it meets localism as constructed by political will through legislation, policy and planning practices. However, with regards to the provision of open and green space in the city these are often in direct opposition to each other. On the roofscape, ecotopia, aligned with private space provision has become a personal ecotopia. Managed and controlled by individuals and, for the protection of biodiversity, scientific experimentation and security, ecotopias are individual spaces where only flora and fauna access freely.

Successful greenroofs appear as a sustainable life-style choice such as Bluebell House, or for commitment to environmentalism combined with earning a living, such as architect Jon Broome or activists John Little. These committed individuals have the power and resources to convert their domestic roofs. Commercial roofs increase revenue by providing bars, cinemas, restaurants and terraces. As Jonathan Lash, President of the World Resources Institute indicates:

> Businesses' engagement in voluntary actions to reduce their impact on Earth's ecosystems can be an engine of positive change in two ways: it can be a source of new opportunities for business, and a means of preserving our natural assets for future generations Jonathan Lash, President World Resources Institute (Percu and Lubchenco 2005:4).

Writing greenroofs into GLA policy and enforcing this through planning departments enables businesses to incorporate them into sustainability strategies and to provide amenity spaces for their employees. Deshi, whose work at the GLA contributed to the city-wide greenroof policy which enables this corporate development and its increased value suggests:

> by far the biggest benefit is access to roof gardens and most developers will recognise that, cos, yeah, if I put a roof garden up here, thats an extra 5 grand, you know. … They are running a business (interview:2011).

A series of green terraces, designed onto a new commercial building on Triton Street in London (completed in 2011) were required by GLA regulation, but were promoted as a superstar feature. They were intended for use by everyone in that building. However, the company who rents one of the offices which has direct access to the terraces insisted on denying that access to the building's other company's employees. This may have been a concern with confidentiality by allowing access to non-employees, but they argued for exclusivity on amenity grounds and they offered to pay a higher rent for the office. A nearby city centre office automatically charges a higher rent for access to their roof garden.

Publicly held land is being systematically transferred into private ownership, a once invisible (Minton:2006), but increasingly recognised practice in London. More accurately, by taking a long historical view, this is the re-privatisation of London (Glasze et al.:2005; Blandy:2006). This is another reason why greenroofs are so successful as a technology and have survived austerity: they align well with already established strategies of privatisation through localism. In many cases, the functions of the lost public spaces are not being replaced by roofscapes. Why is it important to ensure continued access to open or green spaces within a city and why does the privatization of such space matter, especially when local councils align with the greenroof network to (theoretically) provide it through greenroofs?

The insulative affordances which roofs provide and which ecologists, LBZ officers, school boards and researchers claim control of, resinates with:

> an intensifying concern on the part of individuals and families to insulate themselves from the threats to physical, financial and emotional security often associated with contemporary city life (Macleod and Ward 2002:159).

These contribute to the well-documented exclusionary aspects of privatization, built round the aesthetics of security (Davis:2006) which often result in social exclusion (Low et al.:2006) and the reduction in diversity across race, class and culture and the reduction in public meeting spaces and participation in public life (Low:2004; Minton:2006; 2012). Sustainability and security are not mutually exclusive choices but often align in terms of 'sustainability via security' (Armitage and Gamman 2009:298). In the greenroof case this security agenda aligns intentionally and unintentionally through the isolation and gatekeeping practices motivated through notions of protection and provided by London's contemporary roofscapes.

The articulations between localism and privatisation enabled by the affordances of roofs mean that local roofs are chiefly private roofs, aligning with what Evan MacKenzie (1996) refers to as 'privatopias' (see also Macleod and Ward:2002). Privatopias, as Mackenzie describes them are a combination of Ebenezer Howard's garden city and American privatisation: "voluntary ghettoization and self-segregation" (Macleod and Ward 2002:117). In England, as Sarah Blandy (2006) notes, the very particular confluence of the social, economic and political has resulted in the rise of gated communities. These are characterised by specific building forms where whole buildings, not communities of buildings tend to be gated, and like their American counterparts, access is restricted and regulation enforced. This is often accompanied by heavy surveillance and enforced by private security, as in the Jubilee Gardens and the Southbank in London. Blandy also notes, this re-privatisation of public space is driven by contemporary notions of exclusivity, security, convenience and property value, not necessarily the search for community that the US gated communities are centred on.

I raise the issue of privatisation, access and equality with Mary, who is a university greenroof researcher. She indicates: "they are seen as aspirational. They stand out. In a way we quite like, it's got a cache … it gets them built, its an enabling force at the moment." Her misunderstanding of the issue of access reveals that she believes that a disparity exists only between those who have greenroofs and those who do not: "when most of our houses have greenroofs on, then the disparity between the haves and the have-nots will disappear" (pers. comm.). This is typical of the way that greenroofers and researchers do not understand that their biodiversity and ESS agenda is not translating across into an accessible or socially sustainable one. Not all roofs can be greened and most greenroofs only afford access through privilege.

Futures-in-process

The scale of the city enables multiple futures-in-process, allowing the local to be constructed materially. Not all ends-in-view are of equal weight as the Mill Lane roof demonstrates. Revisiting Mill Lane reveals that ecotopia is a pragmatic, ongoing process which requires work (McKenna 2002:3) and money. It is not an end-state but a series of ends-in-view. The residents of Mill Lane still have no access to the community centre roof, designed as it was for that utopian garden vision. The roof houses multiple aspirations, some of which are in direct conflict with the others and no one possesses enough time, energy, patience, money, know-how or will to rectify the sit-

uation. The aspirations for the roof to mimic a brownfield site have been fulfilled in terms of biodiversity as few venture onto it but also because local residents have continued to treat the site as a wasteland and have vandalised it again.

Mill Lane's denied access to residents is a pattern that is repeated so often, much to Frank's disappointment. The best he can suggest is that "its better to get roofs up there for biodiversity and think about the people aspect later". So he, bound by the restraints of his role, the funding and the bureaucratic environment in which he works, envisions a further stage of retrofitting, when circumstances permit. So, rather than say that the end-vision of the greenroof has failed the social, perhaps Frank's optimism for a new person-centred retrofitting chapter in the ongoing story of greenroofing and Mary's willingness to put up with short-term inequality in exchange for expediency and efficiency are both mediated by the belief that inequality will sort itself out in the futures-in-process.

Conclusion

The roof offers multiple affordances for flora and fauna and for people. Affordances for flora and fauna are often incomparable with affordances for people. Different communities of practice hold differing and often conflicting utopian registers. Many though, as they argue for amenity, may also agree that they do not want unrestricted access to 'their' roofs. Often alignments have unexpected consequences when local authorities use greenroofs to reinvent their role as open space providers in an increasingly compact city nudged by reduced funding conditions. The tension between biodiversity needs, argued to be beneficial for society at large through ESS and the social sustainability agenda which argues that people require access to green space in order to remain healthy is at odds.

Breaking the intimate connection between people and land results in 'wilderness'.[10] The physical isolation afforded by roofscapes creates the conditions where wildness is possible by alienating flora and fauna from human contact, but not from other flora and fauna. British native wildflowers in turn construct, shape and reflect local environmental conditions.

Greenroofs solve multiple problems for local authorities, environmental concerns through ESS, SUDs, biodiversity, open space provision and longevity of roofing sur-

[10]This pre-colonial condition provides a 'standard' for restoration practices in the US (Anderson:2005).

faces which result in reduced maintenance budgets. They can be PPP funded or privately provisioned. They may also be used to compensate for parcels of land sold to fund statutory obligations. LBZ officers vary over access, but some are conflicted. While they may argue for access, the ongoing health and safety concerns, costs, and their perceived responsibility to sanitise through regeneration, leaves them satisfied with a retraction to a state of no access for residents.

This can be interpreted as a temporary state, ready for improvement when funding permits futures-in-process. The greenroof network, working for an increase in biodiversity, are willing to align with policy makers and planners to plan for open space provision and use the vegetable roof to do this. They do not mind people having access as long as they do not interfere with the biodiversity. The greenroof researchers do not wish people to interfere with their roofs and when they can attract funding they build their own research roofs with strictly no access to outsiders. Overall, the pattern of building greenroofs is located within the private sector.

11

Conclusion

Human relations in respect to Nature within the Anthropocene (Crutzen and Stoermer:2000) are increasingly expressed in terms of the concern over changing climates. This forces the agentive relations between humans and the material world more sharply into anthropological focus. At the heart of this work revolve notions of what Nature is, its function and what the possibilities and conditions of its use might be. Until recently, the natural world has been expressed in terms of control, bracketing it off in order to appropriate, sell and use it without seeming to acquire consequences. However, Anthropocenic discourse now positions the natural world as out of control, *our* control, and this brings into question power and late capitalist notions of appropriation and consumption. Using the case of greenroofs, this research investigates how notions of Nature are being materialised in cities, where over half the world's population now live, with London as the fieldsite.

Visions of what a future London will look like, the futures-in-process, are a pragmatic ecotopianism, based on governing, not only for a changing climate, but a city set to become more compact. This ecotopian impulse places plants at the heart of the project, so in order to consider this practice, plants become central to analysis. Plants and landscapes and are an interesting challenge to material culture studies, as they are socially manipulated, constructed but also independently alive and agentive. While there are some anthropological accounts of plant species, they tend to be regarded as collectives: parks, gardens where they contribute and provide a backdrop to hu-

man sociality, rather than as a central material for people to think through ideas and action. There is very little social science on greenroofs and this is the first (known) anthropological literature. In this sense it spans and contributes to material culture and the wider literature on affordances, landscapes, sustainability, urbanism and in particular, urban-greening, policy and organisational literature.

In order to think through the material culture of greenroofs, the thesis explores one of the pillars of material culture studies: Gibson's affordance theory. Firstly, the rapprochement which affordance theory promises between the ecological sciences where the place of the anthropos is problematic and the social sciences where human/non-human relations are inadequately theorised, has proved a useful starting point. Affordance theory has highlighted, via current biological research, Peircian semiotics and Baradian agental realism, a recognition that the base materials of the world can no longer be regarded as meaningless and external to the human social. It has also pointed to a recognition that agency, the capacity to take meaningful action, is not just a human quality or possession. It is emergent from the reciprocal interactions of humans and the non-human world. The material culture pushes back: it always has meaning.

While affordances can be a good way to think through the material world and what it enables, there are two further points which the thesis makes about the theory. First, Gibson describes affordances as a neutral field, although in later life, he describes them as both physical and mental, contained in values or meanings (1982:129). This resonates well with the material culture notion of a reciprocal relationship between the material world and human sociality. One of the affordances of Nature is that it can be used to think with and to develop emotion, something Barad's ethics of care addresses. However, it must be recognised that this is a second order effect - not 'inbuilt' to nature, or part of the materiality of an object, although the object enables the ability to think through certain things because of what it is, physically. Respondents proceed as if Nature were external and moral; because this enables them to think through greenroofs, make claims about existential threats, ways of living and 'saving' the earth by extending political and material action. Affordances, like nature itself, become a moral field populated with actors who attempt to control and enforce meanings, in order to imagine and manage the future cityscape of London.

In addition, these have secondary effects and go on to produce other affordances, so for example, greenroofs have multiple benefits which enable them to exist in different registers, like policy and photographs. The unintended consequences of affordances were discussed in chapter nine. Policy on greenroofs enables ecologists, activists, the

GLA and local authorities to argue that they can replace land on the ground with land on top of buildings. This has real social consequences because this equivalency does not stand scrutiny, biologically, politically or socially.

This leads to the last conclusion about affordance theory: that conflicting affordances reveal aspects of the way power operates within a context. Ecotopian futures centred on the built environment are continually contested through the space-making practices that coalesce on the roof. The roofscape becomes a new commons, one of control, power and regulation but simultaneously, of hope and of the production of natures which are argued to regulate and manage the changing environment. Space, slippages in policy and practice come together and are managed there by respondents.

Affordances designed for the development and protection of ecotopias often stand in direct competition with social agendas centred round compact cities, reduction in public services and statutory requirements. These conflicting or competing ecotopian registers make visible the power relations in London's governance and demonstrate that while ecological problems are gradually moving out of ecological departments to become more pertinent to multiple governance actors, greenroofs still have a long way to go before they become normal, everyday, 'natural'. Other materials, money, the power of leaseholders or migrating snails acquire an unforeseen, unanticipated power to afford agentive material consequences. Managing these conflicting utopian registers means expressing power over other social actors. End-visions have not always been in accord with material realities, turning ecotopia (for some) into nature-out-of-place or privatopia (for others).

In light of the way plants often assume the position of backdrop to sociality, I made the claim that the materiality of plants and how they are understood should be called phyto-materiality. Greenroofs are successful because of their materiality - alive and active, producing effects on the material nature of the city, independent of human observers. They are almost the perfect neoliberal product: flexible; adaptable; hugely variable but recognisably one form; move effortlessly between global and local; multifunctional; self-reliant and self-reproducing. They can be anything from a simple one species mat to a biodiverse brown roof or a park on a church and if required, a vegetable garden. They can be recognisable across scales from a garden shed to a world heritage site and from the historical, vernacular sod roof on a holiday cottage to an instant roll-out sedum mat on the newest London skyscraper. Greenroofs are as versatile and flexible as they are enchanting.

It is still too early to evaluate what kind of Nature the greenroofs built since 2000 in London are productive of. However, the expectations of nature mirror the expec-

tations of contemporary economics and utopias: self-reliance, self-sustaining, small, individual and local. Even if greenroofs are humanly created habitats, leaving them relatively undisturbed, or under the care of an expert guardianship, allows them to be envisioned as achieving wildness, constructing, mimicking or creating an authentic local character. This wildness and local character can be identified and described as such because the discrete, non-human agencies over time produce complex webs of biodiversity, dependant not on humans, but on the affordances offered by greenroofs.

The traces my respondents have woven and which they materialise through networking, policy and greenroof creation suggest that their notions of what nature is and how it should be treated, regulated, governed and manipulated are both informed and come out of a typical British environmentalism. These are drawn together through the material form of the greenroof and become anthropologically significant through the kinds of ecological subjectivity and citizenship this creates. The intent throughout has been to describe respondents as real "flesh-and-blood people rather than merely ciphers of a larger collectivity" in order to relay how contingent and context dependant policy-making, change and social reform is (Giddens 1994:98). This has been risky because careers are at stake, and individuals who consider themselves involved in this process may feel ignored or over analysed, and I have done my best to mitigate these possibilities. Many changes have occurred since starting to write, not least the change in the BAP reporting system and the increase in number and visibility of greenroofs. At the time of printing an updated GLA greenroof policy is in production. Like many other ethnographic accounts, this is fixed within an anthropological present, despite the claims of futures-in-process, because continual updating is impossible. So, this is already something of an historical document.

I keep returning to what Frank and Mary say about their futures-in-process and the way they pragmatically work to get greenroofs laid. They suggest that it is better to lay them now, imperfectly and attend to issues of inequality later. Acting in stages makes the impossible possible. Greenroofs have changed the processes of governance at the local and city levels and one officer or researcher, as they point out, cannot do everything. However, I also recall the image of the side of the house where a group of families are about to loose their outdoor eating and games area and cannot help but feel that Frank and Mary's futures-in-process are too easy to leave dormant as futures-in-potential. More political will and reflexivity is therefore required to ensure a more even distribution of ecotopia. As another Gibson, this time William, so eloquently suggests "the future is here now - it is just unevenly distributed" (O'Toole:2012).

A

Photographs

All photographs were taken by the author unless otherwise stated.

Figure A.1: Sedum: Plants and sedum mat rolled up and ready to lay

Figure A.2: Eversheds greenroof

Figure A.3: Black redstart. Permission to reproduce this has been granted by Brian Stone (thenaturastone.blogspot.co.uk)

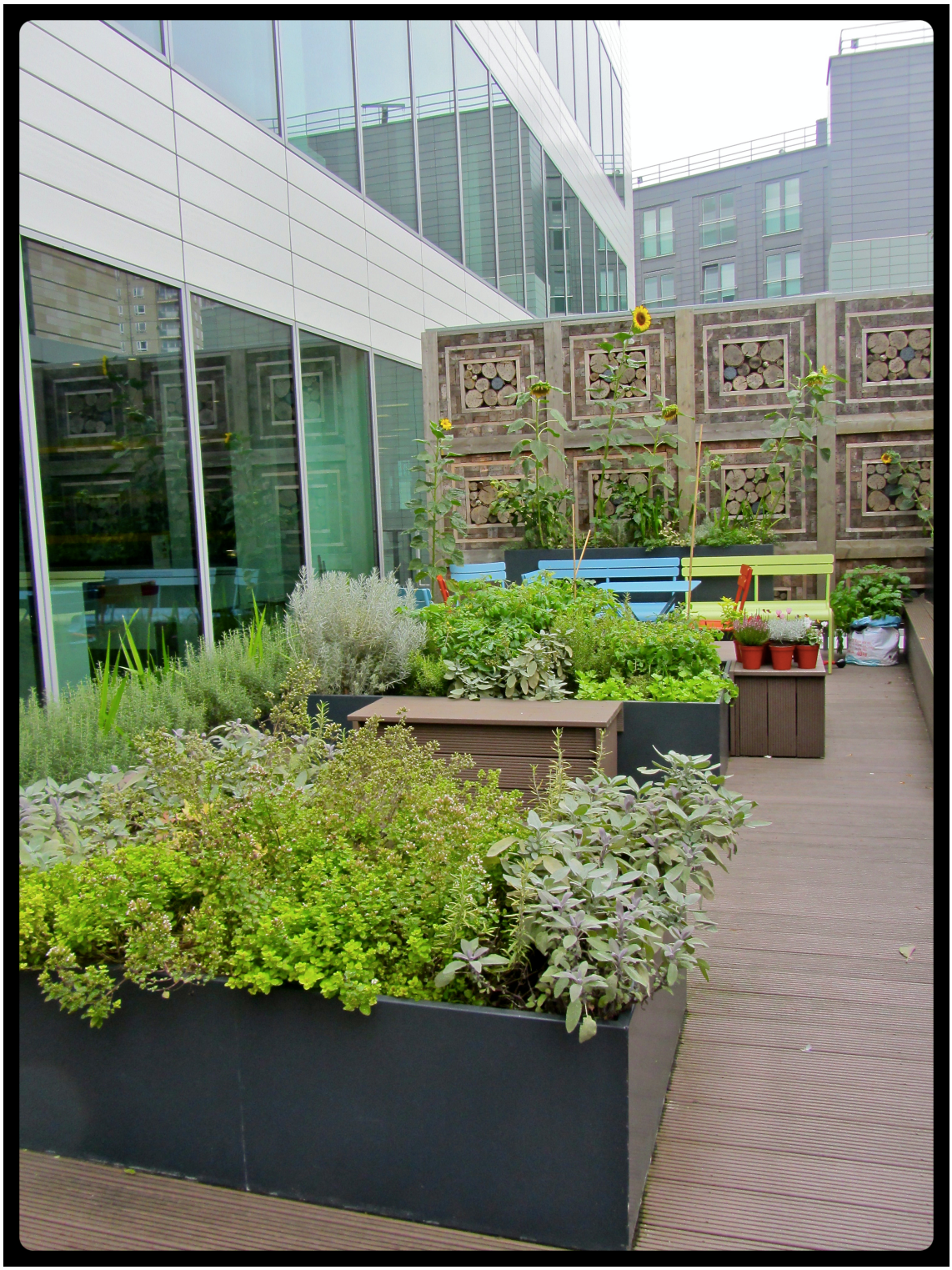

Figure A.4: Bee hotel and raised herb beds on commercial staff terrace

Figure A.5: Centre for Understanding the Environment, Horniman Museum Extension

Figure A.6: Holiday cottages in Norway. Permission to reproduce this has been granted by Peter Bourke.

Figure A.7: Bluebell House

Figure A.8: Mill Lane Community Centre Top left: swale construction Bottom left: planting (note hills and valleys) Right: material layers

Figure A.9: Mill Lane Community Centre Permission to reproduce photographs top right and left has been granted by the London Permaculture Flickr

Figure A.10: Dewey Court

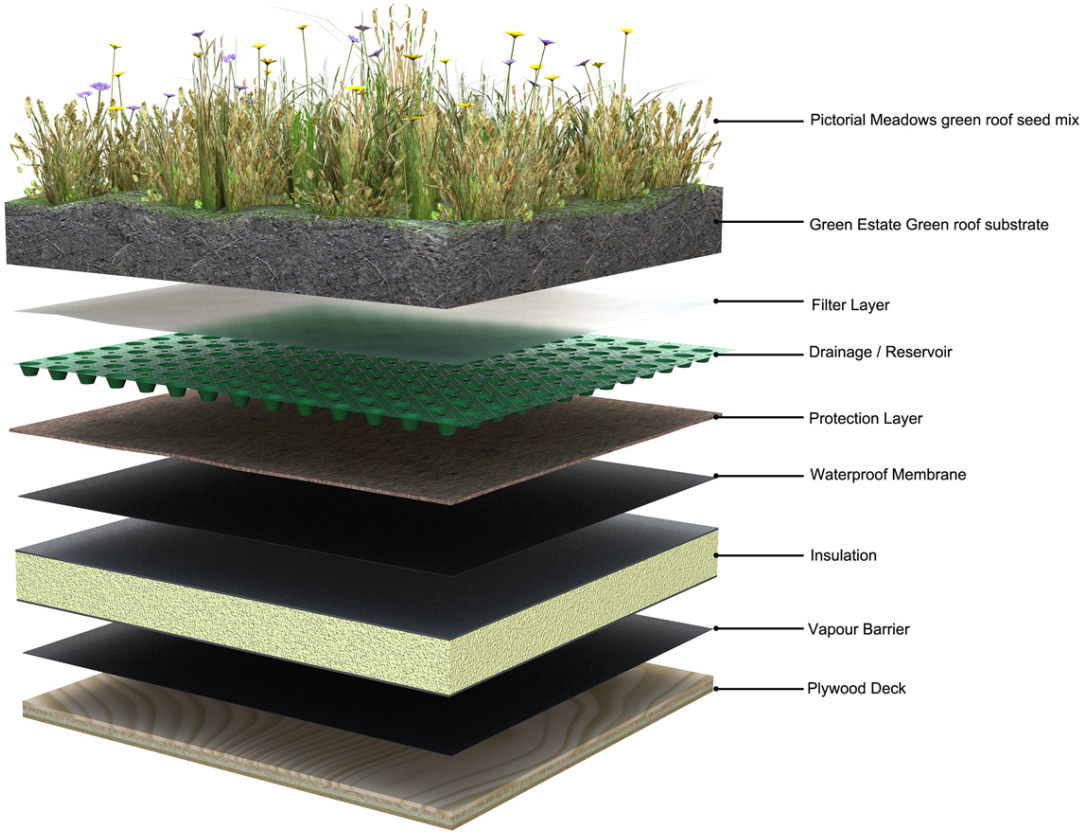

Figure A.11: Greenroof Layers. Permission to reproduce this has been granted by Alex Johnson (www.aj-3d.com/index.htm)

Figure A.12: Orchids on the Moos Lake Water Treatment Plant. Permission to reproduce this has been granted by Dr Stephan Brenneisen

Figure A.13: Greenroof test beds

B

Number of Greenroofs

Table B.1: Recoded from Greenspace information for Greater London (GiGL) 2012

London Borough	Number of Greenroofs
Camden	205
City of London	42
Lambeth	38
Westminster	37
Hackney	32
Kensington and Chelsea	26
Southwark	25
Tower Hamlets	25
Haringey	24
Islington	24
Wandsworth	24
Barnet	17
Greenwich	17
Croydon	16
Lewisham	13
Hammersmith and Fulham	13

London Borough	Number of Greenroofs
Barking and Dagenham	12
Merton	11
Newham	10
Hounslow	9
Richmond upon Thames	9
Brent	8
Enfield	8
City of Westminster	5
Ealing	5
Waltham Forest	4
Kingston upon Thames	2
Redbridge	2
Sutton	2
Bromley	1
Harrow	1
Total number greenroofs	**682**
Total area of greenroofs	**635,596**

C

Proposed Plant list for Mill Lane Community Centre Greenroof

- Common toadflax (*Linaria vulgare*) food plant of the Toadflax Brocade Moth (*Calophasia lunula*) – a UK BAP priority top species, Common Vetch (*Vica sativa*), which generates aphids – an important food source for House sparrows (*Passer domesticus*) a London and LBZ Priority BAP species, Birds foot trefoil (*Lotus corniculatus*) food plant of the Common blue butterfly (*Polyommatus icarus*) and Kidney vetch (*Anthyllis vulneraria*) important food plant for the Small blue butterfly (*Cupido minimus*).

- A number of the specified wildflowers are known nectar sources for *Bombus humilis* and sylvarum and other long-tongued bees, including Vipers bugloss (*Echium vulgares*).

- Autumn Hawkbit (*Leontodon autumnalis*) will be planted to provide for a very rare beetle that is included in the Olympic BAP (*Olbrus flavicornis*).

- The provision of logs across the roof, some of which will be semi buried, will provide habitat for Stag beetle (*Lucanus cervus*) larvae.

- Muscari and Croci bulbs will be planted into mounded in groups of five. Observations in London have shown that not only do these early bulbs provide an

early nectar source for bees but act as beacons for nesting Andrena sp allowing them to locate their nest burrows (*Green Roof Approved Specifications* 10/08/09).

The list also included wildlife friendly garden plants (a mix of native and non-native) for visual display and foraging habitat for bees, butterflies and other invertebrates:

- Catmint (*Nepeta cataria*)
- Common Toadflax (*Linaria vulgare*)
- Purple Toadflax (*Linaria purpurea*)
- Spiked speedwell (*Veronica spicata*)

The plug plants ordered and planted:

- Fall dandelion (*Leontodon autumnalis*)
- Bird's-foot trefoil (*Lotus corniculatus*)
- Cowslip (*Primula ceris*)
- Deptford pink (*Dianthus armeria*)
- Kidneyvetch (*Anthyllis vulneraria*)
- Lady's bedstraw (*Galium verum*)
- Maiden pinks (*dianthus deltoides*)
- Oregano (Wild marjoram) (*Origanum vulgare*);
- Ox-eye daisy (*Leucanthemum vulgare*)
- Jupiter's beard (*Centranthus ruber*)
- Common rock-rose (*Helianthemum nummularium*)
- Salad burnet (*Sanguisorba minor*)
- Red catchfly (*Lychnis viscaria*)
- White campion (*Silene alba)*
- Chives (*Allium schoenoprasum*)

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